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THE AMENDMENT OF THE LAW RELATING TO LETTERS PATENT FOR INVENTIONS.

The Government Bill recently introduced, and to which we have already referred in our previous articles on the above subject, although best known by its short title, "The Patents for Inventions Bill," does really cover a much wider field than that of letters patent for inventions, as it is designed to amend and consolidate in a single Act the provisions of the numerous laws relating to patents, designs, and trade marks; and the Government must certainly be congratulated on the bold and comprehensive character of the measure which they have formulated.

We do not propose here to consider the alterations contemplated by the Bill affecting the law of trade marks, but probably an observation or two on some of its provisions relating to copyright in designs will be of interest to our readers.

Under the present system there are two classes of designs,—viz., useful and ornamental—and they are registered under separate Acts, the main features, however, of which are the same.

It is often difficult—as stated in the official memorandum on the Bill—to decide to which class a design belongs, and sometimes still more difficult to determine whether a so-called useful design is or is not subject matter for a patent. Under the Useful Designs Act protection can only be obtained for novelty in the shape or configuration of the parts of the design; it is manifest, therefore, that where a mechanical action is involved it is an incongruity, and a straining of the construction of the Act to endeavour to protect apparatus of this class under it. The only reason why so many inventions relating to mechanical apparatus have been registered as useful designs is on account of the difference in cost between a design-copyright and a patent; but in cases of this kind the protection obtained under the Designs Act is purely nominal, since the novelty of such designs consists in some mechanical principle, whilst the proprietor is compelled to limit his claim to peculiarities in shape or configuration.

It is now proposed to discontinue the distinction between ornamental and useful designs, and to accept for registration *any* novel design, the word *design* being restricted in its definition to the natural and proper sense of the term. Such useful designs as embrace a mechanical action are to be treated as subject matter for a patent, so that the public will secure a more effective protection for designs of this class, whilst as the cost of a patent is to be considerably reduced they will not suffer in a pecuniary way by the change.

It is also proposed to adopt a fixed and uniform term of four years as the duration of the copyright of all designs, instead of the various terms of copyright under the existing system.

Having just cursorily glanced at that part of the Bill which relates to the law of copyright in design, we next propose to consider some of the other provisions of the Bill affecting the law of patents for inventions.

And first with regard to the question of fees, to which we have already adverted. It is proposed, then, to reduce the first cost of a patent to £4, the two subsequent duties, however, of £50 and £100 respectively, remaining the same, although the payment of the £50 duty is deferred to the fourth year. Considerable dissatisfaction has been felt and expressed at the retention of the two duties for the maintenance of the patent at their present high figure, but it should be remembered that the working expenses of the Patent Office will be greatly increased under the new *régime* and the requisite funds to defray the same must be raised at some stage or stages of the patents; and while we will not go so far as to say that the present figures of the duties of maintenance might not be advantageously reduced, we may at least urge this consideration, that the tax is imposed on the right class, viz., successful patentees, as few others would proceed beyond the fourth year of the patent. At the same time there is considerable force in the objection that the reduction in fees is more apparent than real, as under the new Act it is proposed to stringently enforce the regulation that each application shall be limited to *one* invention, so that a larger number of patents will have to be taken to cover the ground, which can be included in one patent under the existing system.

It is further proposed to simplify procedure and reduce the number of documents necessary in obtaining a patent. The application will be made by the deposit of a declaration and provisional specification, and the completion of the patent will be effected by the deposit of the complete specification with the fee for sealing. Provision is also made for transacting all the business of the Patent Office by post, so as to avoid on the part of the patentee the payment of agency fees, the stamped forms being also procurable by post; but as few inventors are competent to prepare their own specifications, it is questionable how far they are likely to benefit by this privilege.

The Bill also makes provision for the grant of compulsory licences, a provision, as we have before said, of questionable advantage and doubtful expediency.

The duration of patents remains unaltered, but the period of provisional protection is extended from six to fifteen months. The final specification, however, has to be deposited before the grant of the patent, viz., within *nine* months from the date of application, so as to allow time for objections and for its examination and comparison with the provisional specification.

This brings us back to the principal feature of the Bill, viz., the examination of applications and the examining and judicial bodies which are to be invested with important powers under the Act.

We have already called attention to the fact that the examination should include the consideration of *novelty*, and have also pointed out the error and danger of requiring patentees to formulate their claims at the time when they deposit their provisional specifications. It now remains to be seen what machinery the Bill has provided for carrying its provisions into effect.

The head of the Patent Office (as also of the Designs and Trade Marks Departments) is to be an officer, called the

Comptroller-General of Patents, Designs, and Trade Marks, appointed by the Board of Trade with the approval of the Treasury, and he is to act under the superintendence and direction of the Board of Trade; and there may also be appointed so many examiners and other officers and clerks, with such designations and duties as the Board of Trade think fit. Under these provisions an efficient examining body might be organised, which would prove of the greatest benefit to both inventors and the public.

It is greatly to be feared, however, that owing to the dislike which is entertained in many quarters to any system of examination, and the consequent opposition that the Government proposals have evoked, that these provisions of the Bill which we are now considering will be rendered nugatory. For example, it is strongly urged that the requisite staff of examiners would not be immediately forthcoming, but that it would take years to train a sufficient number of gentlemen for the purpose. We do not for one moment believe that any difficulty of the kind would be experienced. There are a large number of assistants in the principal Patent Agency Offices of the kingdom fully qualified to act as examiners, and there are others more or less connected with the profession whose services might no doubt be secured if a sufficient inducement were offered to them. It is greatly to be regretted, therefore, that when there was a prospect of a radical improvement being effected in patent procedure, the good intentions of the Government should have been nipped in the bud by ill-advised expressions of opinion as to the practicability of the Government proposals.

That this is the effect which has been produced is evident from the recent speech of Mr. Chamberlain, on the occasion of the second reading of the Bill, in which that gentleman distinctly informed the House that the examination contemplated by the Bill would be of a very perfunctory and formal character, as he did not consider it practicable to attempt any inquiry into the novelty of subject matter of applications for patents. We still hope, however, that during the progress of the Bill through Committee, pressure will be brought to bear upon the Government to secure that thorough system of examination which is called for by the flagrant abuses of the existing system to which we have directed attention.

While we are dwelling upon this part of the Bill, we cannot refrain from expressing our conviction that the vice of the Government measure consists in an evident desire to graft the new branches upon the old stock, or, in other words, to retain the existing system as much as possible and make the new machinery simply an auxiliary. Thus, for example, we find that there is to be an appeal from the decision of the examiners or comptroller to the law officers of the Crown. Now, every one who has any knowledge of the working of the existing system will be able to estimate the benefit to be derived from this provision at its true value, and will see that it would prove absolutely unworkable when put to a practical test. The proposals of the Society of Arts' Bill for the appointment of commissioners who form a court of appeal from the decisions of the examiners would be much more feasible, provided that the commissioners be selected for their combined legal and scientific acquirements; and we commend this suggestion to the consideration of those interested in the question in order that it may be strongly urged upon the Government during the examination of the Bill in Committee.

Among other proposals of the Bill we may mention the empowering of the Comptroller to extend the time for payment of the fourth and seventh years' duties, in special circumstances, on payment of a fine, provisions for revocation of patents on petition to the Court of Chancery, and the inflicting penalties for marking as patented articles which are not the subject of a patent, and also for using the royal arms without permission.

No doubt many of these provisions are desiderata which should find a place in any complete measure of patent law reform, but if the system of examination is not effectually carried out it is questionable whether, were it not for the reduction in the fees, the advantages gained will be worth the trouble of passing the Bill, since it will leave untouched the very points on which an amendment of the law is most needed to meet the exigencies both of genuine inventors and of the important industrial interests of the country.

T. J. HANDFORD.

THE CHEMISTRY OF THE PLANTÉ AND FAURE ACCUMULATORS.*

PART V.

1. *Influence of Strength of Acid.*

IN the second part of this communication in *Nature*, vol. xxv., p. 461, when treating of the charging of the cell, we pointed out that in the electrolysis of dilute sulphuric acid between lead electrodes, two totally different reactions might be obtained. The positive metal becomes thinly coated with lead sulphate when the current employed is of small density, but with lead peroxide when the density of the current is of greater magnitude. This latter action is, of course, what takes place in the ordinary formation of a Planté battery. The chemical change, therefore, which goes on at the positive electrode is to a certain extent dependent upon the strength of current.

It appeared also of both theoretical and practical interest to determine whether the chemical change was also influenced by the strength of the acid employed. Our experiments consisted in passing a current of uniform strength, about 1 ampère, between electrodes of lead, 12 square inches in size, in varying strengths of sulphuric acid, and estimating in each case the amount of oxygen fixed by the positive electrode. We determined this for successive five minutes of time, and as such actions are not always very uniform, we made in each instance more than one experiment. The results are given in the following table :—

Strength of acid.	Experiment.	Percentage of oxygen fixed.				
		First 5 mins.	Second 5 mins.	Third 5 mins.	Fourth 5 mins.	Total.
1 to 5	I.	38·1	28·6	28·6	33·3	128·6
	II.	39·5	30·2	25·6	30·2	125·5
1 to 10	I.	43·4	38·7	29·2	34	145·3
	II.	44·1	39·3	29·3	34·9	147·6
1 to 50	I.	48·3	39·6	35·3	22·4	145·6
	II.	46·2	43·9	23	30	143·1
	III.	54	40	35·3	35·5	165
1 to 100	I.	42	38·3	33·9	29·5	143·7
	II.	42·4	40	37·8	35·5	155·7
	III.	51·1	44·2	34·9	34·9	165·1
1 to 500	I.	46·6	32·6	27	27	132·6
	II.	46·4	27	27	18	118·4
1 to 1000	I.	90·6	81·1	76·4	57·5	305·6
	II.	90·8	77	72·3	63·1	303·2

It appears from this that the strong sulphuric acid (1 to 5) is not quite so favourable to the action as the more dilute (1 to 10), but that between this latter proportion and 1 to 500 there is no great difference in the amount of oxygen fixed, and therefore of corrosion of the plate. The appearance of the plate in every instance indicated the formation of only lead peroxide. With sulphuric acid diluted with 1,000 parts of water, the amount of oxygen fixed, and therefore of corrosion, was at least doubled, while the chemical action was very different. On parts of the electrode, streaks of a mixture apparently of the yellow and puce-coloured oxides were seen. On other parts a white substance formed and was easily detached, falling in clouds into the liquid. Where this latter action took place the plate was visibly the most corroded. This white substance gave on analysis SO_4 equivalent to 73·6 per cent. of lead sulphate, suggesting the idea that it was a basic sulphate of the composition $2PbSO_4,PbO$, which would require 73·1 per cent. As the peroxidation of the lead is required, and the corrosion of the plate is to be avoided as much as possible, it is evident that this extremely dilute acid must be avoided. It has already been shown that if the sulphuric acid is entirely removed from solution, as sometimes happens in an accumulator, the lead is simply converted into the hydrated protoxide, and therefore corroded without any good effect.

2. *Function of Hydrogen.*—In the formation of a secondary cell, after the complete reduction of oxide or sulphate

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* Drs. Gladstone and Tribe, in *Nature*, April 19th.

to metallic lead, bubbles of hydrogen gas are seen to escape from the lead plate. It has been assumed that a portion of this is occluded by the lead, or in some other way enters into association with it, and it has been supposed that this hydrogen compound may play an important part in the subsequent production of electromotive force. It therefore appeared desirable to obtain experimental evidence as to whether hydrogen is so absorbed. The process we adopted for this purpose was founded upon the observation of Graham that hydrogen associated with palladium reduced ferri to ferro-cyanide of potassium, and that generally in the occluded condition the element was more active chemically. We had previously ascertained that hydrogen associated with other elements, as platinum, copper, and carbon, was capable of reducing potassium chlorate to chloride. This method seemed to give trustworthy results, and therefore we applied it in this instance. As the result of several trials, however, we found that the amount of hydrogen associated with the reduced lead was almost inappreciable. Small as this quantity is, however, it is by no means impossible that it may be the cause of the exceedingly high electromotive force observed for the first few moments, on joining up a completely formed cell immediately after its removal from the circuit of the charging current. This, however, may be due, as Planté imagined, to the gaseous hydrogen itself. The principal if not the only function of the hydrogen of the water or sulphuric acid is, therefore, that of reducing the lead compounds.

By a totally different process Prof. Frankland has very recently come to the same conclusion as ourselves in regard to the exceedingly small amount of occluded hydrogen.

3. *Evolution of Oxygen from the Peroxide Plate.*—Planté noticed a small escape of gas from the negative plate of his cell immediately after its removal from the influence of the charging current. This he attributed to a decomposition of water by means of local circuits between the peroxide and the subjacent lead plate in contact with it.

The explanation we gave in our first paper (*Nature*, vol. xxv., p. 221) of the local action which goes on at the negative plate does not account for the escape of any gas—either oxygen or hydrogen. We therefore thought it of interest to ascertain the nature, and if possible the origin of the gas noticed by Planté.

We found that the escape of gas from a Planté negative plate was very slight, and soon ceased; but we observed that it became much more pronounced when the temperature of the electrolytic liquid was raised. In order to get a sufficient quantity of the gas for examination, we prepared a negative plate according to the procedure of Faure, and then heated it in dilute acid, with an arrangement for collecting the gas as it was evolved. The amount of gas was still very small in comparison with that of the peroxide, but a sufficient quantity was collected to enable us to ascertain that it was oxygen. We next heated some of the electrolytic peroxide apart from the lead plate, and again noticed a similar evolution of gas, which was also found to be oxygen. This shows, therefore, that it was not a result of local action.

The gas has generally some odour of ozone, and, on testing the dilute acid between the plates of a Planté cell, we always found traces of something that bleached permanganate of potassium, and which might be either ozone or peroxide of hydrogen.

The origin of the gas noticed by Planté may be easily attributed to the oxygen which always passes off in quantity from the peroxide plate during the process of "formation." It is only necessary to suppose that some of this becomes condensed on the peroxide, and is gradually eliminated from it when the surrounding conditions are changed. But the matter is capable of another explanation. If peroxide of hydrogen be really formed in the liquid, it will exert its well-known influence on higher oxides, namely, that of reducing them and itself at the same time. As a matter of fact, if peroxide of lead is dropped into peroxide of hydrogen oxygen is evolved.

4. *Temperature and Local Action.*—Planté has recently pointed out that an elevation of temperature facilitates the formation of his secondary cell (*Comptes Rendus*, August, 1882). The character of the chemical changes which took place at the negative plate led us to think it exceedingly probable that this increase in the rate of formation arose from an augmentation in the amount of local action. Experiment showed such to be the case. Pairs of similar negative plates on Planté's model were allowed to remain in repose at 11° C. and 50° C., respectively, and the formation of the white sulphate was visibly more rapid at the higher than at the lower temperature. The same is also true with negative plates prepared by Faure's process. Thus we found that two similar plates kept in repose for an hour, the one at 11° C., and the other at 50° C., formed by local action 2·6 and 7·4 per cent. of lead sulphate respectively. On two other plates the proportions were 7·6 and 9·5 per cent. respectively. These observations, of course, by no means exclude the idea that an increase of temperature may facilitate the other chemical changes that take place in the formation of a lead and lead-oxide cell.

I. THE TRANSMISSION OF POWER BY ELECTRICITY.

II. THE PORTRUSH ELECTRICAL RAILWAY.

By ALEXANDER SIEMENS and EDWARD HOPKINSON, D.Sc.

(*Continued from page* 324.)

II.—THE PORTRUSH RAILWAY.

In the summer of 1881, Mr. W. A. Traill, late of H.M. Geological Survey, suggested to Dr. Siemens that the line between Portrush and Bushmills, for which parliamentary powers had been obtained, would be suitable in many respects for electrical working, especially as there was abundant water-power available in the neighbourhood. Dr. Siemens at once joined in the undertaking, which has been carried out under his direction. The line extends from Portrush, the terminus of the Belfast and Northern Counties Railway, to Bushmills in the Bush valley, a distance of six miles. For about half-a-mile the line passes down the principal street of Portrush, and has an extension along the Northern Counties Railway to the harbour. For the rest of the distance the rails are laid on the seaside of the county road, and the head of the rails being level with the ground, a footpath is formed the whole distance, separated from the road by a kerbstone. The line is single, and has a gauge of three feet, the standard of the existing narrow gauge lines in Ulster. The gradients are exceedingly heavy, as will be seen from the diagram, being in parts as steep as 1 in 35. The curves are also in many cases very sharp, having necessarily to follow the existing road. There are five passing places in addition to the sidings at the termini and at the carriage depôt. At the Bushmills end the line is laid for about 200 yards along the street, and ends in the market-place of the town. It is intended to connect it with an electrical railway from Dervock, for which parliamentary powers have already been obtained, thus completing the connection with the narrow gauge system from Ballymena to Larne and Cushendall. About 1,500 yards from the end of the line there is a waterfall on the river Bush, with an available head of 24 feet, and an abundant supply of water at all seasons of the year. Turbines are now being erected, and the necessary works executed for employing the fall for working the generating dynamo machines, and the current will be conveyed by means of an underground cable to the end of the line. Of the application of the water-power it is unnecessary to speak further, as the works are not yet completed. For the present, the line is worked by a small steam-engine placed at the cariage depôt at the Portrush end. The whole of the constructive works are being designed and carried out by Mr. Traill, assisted by Mr. E. B. Price.

The system employed may be described as that of the separate conductor. A rail of ⊤-iron, weighing 19 lbs. to the yard, is carried on wooden posts, boiled in pitch, and placed 10 feet apart, at a distance of 22 inches from the inside rail and 17 inches above the ground. This rail comes close up against the fence on the side of the road, thus forming an additional protection. The conductor is connected by an underground cable to a single shunt-wound dynamo machine, placed in the engine-shed, and worked by a small agricultural steam-engine of about 25 indicated horse-power. The current is conveyed from the conductor by means of two springs, made of steel, rigidly held by two steel bars placed one at each end of the car, and projecting about 6 inches from the side. Since the conducting rail is iron, while the brushes are steel, the wear of the latter is exceedingly small. In dry weather they require the rail to be slightly lubricated; in wet weather the water on the surface of the iron provides all the lubrication required. The double brushes, placed at the extremities of the car, enable it to bridge over the numerous gaps, which necessarily interrupt the conductor to allow cart ways into the fields and commons adjoining the shore. On the diagram the car is shown passing one of these gaps; the front brush has broken contact, but since the back brush is still touching the rail, the current has not been broken. Before the back brush leaves the conductor, the front brush will have again risen upon it, so that the current is never interrupted. There are two or three gaps too broad to be bridged in this way. In these cases the driver will break the current before reaching the gap, the momentum of the car carrying it the 10 or 12 yards it must travel without power.

The current is conveyed under the gaps by means of an insulated copper cable carried in wrought-iron pipes, placed at a depth of 18 inches. At the passing places, which are situated on inclines, the conductor takes the inside, and the car ascending the hill also runs on the inside, while the car descending the hill proceeds by gravity on the outside lines.

From the brushes the current is taken to a commutator worked by a lever, which switches resistance-frames placed under the car, in or out, as may be desired. The same lever alters the position of the brushes on the commutator of the dynamo-machine, reversing the direction of rotation, in the manner shown by the electrical hoist. The current is not, as it were, turned full on suddenly, but passes through the resistances, which are afterwards cut out in part or altogether, according as the driver desires to run at part speed or full speed.

From the dynamo the current is conveyed through the axle-boxes to the axles, thence to the tyres of the wheels, and finally back by the rails, which are uninsulated, to the generating machine. The conductor is laid in lengths of about 21 ft., the lengths being connected by fish plates and also by a double copper loop securely soldered to the iron. It is also necessary that the rails of the permanent way should be connected in a similar manner, as the ordinary fish-plates give a very uncertain electrical contact, and the earth for large currents is altogether untrustworthy as a conductor, though no doubt materially reducing the total resistance of the circuit.

The dynamo is placed in the centre of the car, beneath the floor, and through intermediate spur gear drives by a steel chain on to one axle only. The reversing levers, and also the levers working the mechanical brakes, are connected to both ends of the car; so that the driver can always stand at the front and have uninterrupted view of the rails, which is of course essential in the case of a line laid by the side of the public road.

The cars are first and third-class, some open and some covered, and are constructed to hold twenty people, exclusive of the driver. At present, only one is fitted with a dynamo, but four more machines are now being constructed by Messrs. Siemens Bros., so that before the beginning of the heavy summer traffic, five cars will be ready; and since two of these will be fitted with machines capable of drawing a second car, there will be an available rolling stock of seven cars. It is not intended at present to work electrically the portion of the line in the town at Portrush, though this will probably be done hereafter; and a portion, at least, of the mineral traffic will be left for the two steam-tramway engines, which were obtained for the temporary working of the line pending the completion of the electrical arrangements.

Let us now put in a form suitable for calculation, the principles which Mr. Siemens has illustrated in a graphic form more convenient for the purposes of explanation, and then show how these principles have been applied in the present case.

Let L be the couple, measured in foot-pounds, which the dynamo must exert in order to drive the car, and w the necessary angular velocity. Taking the tare of the car as 50 cwt., including the weight of the machinery it carries, and a load of twenty people as 30 cwt., we have a gross weight of 4 tons. Assume that the maximum required is that the car should carry this load at a speed of seven miles an hour, on an incline of 1 in 40. The resistance due to gravity may be taken as 56 lbs. per ton, and the frictional resistance, and that due to other causes, say 14 lbs. per ton, giving a total resistance of 280 lbs., at a radius of 14 inches. The angular velocity of the axle corresponding to a speed of seven miles an hour, is 84 revolutions per minute. Hence $L = 327$ foot-pounds, and

$$w = \frac{2\pi \times 84}{60}$$

If the dynamo be wound directly on the axle, it must be designed to exert the couple L, corresponding to the maximum load, when revolving at an angular velocity w, the difference of potential between the terminals being the available E.M.F. of the conductor, and the current the maximum the armature will safely stand. This will be the case in the Charing Cross Electrical Railway. But when the dynamo is connected by intermediate gear to the driving wheels only the product of L and w remains constant, and the two factors may be varied. In the present case L is diminished in the ratio of 7 to 1, and w consequently increased in the same ratio. Hence the dynamo, with its maximum load, must revolve at 588 revolutions per minute, and exert a couple of forty-seven foot-pounds. Let E be the potential of the conductor from which the current is drawn, measured in volts, C the current in ampères, and E_1 the E.M.F. of the dynamo. Then E_1 is proportional to the product of the angular velocity, and a certain function of the current. For a velocity Ω, let this function be denoted by f (c). If the characteristic of the dynamo can be drawn, then f (c) is known.

We have then

$$E_1 = \frac{w}{\Omega} f(c) \qquad (1.)$$

If R be the resistance in circuit, by Ohm's law,

$$C = \frac{E - E_1}{R}$$

$$= \frac{E - \frac{w}{\Omega} f(c)}{R}$$

and therefore

$$w = \frac{\Omega (E - C R)}{f(c)} \qquad (2.)$$

Let a be the efficiency with which the motor transforms electrical into mechanical onergy, then—

$$\text{Power required} = L\, w = a\, E_1\, C$$

$$= a\, C \frac{w}{\Omega} f(c)$$

Dividing by w,

$$L = -\frac{a\, C f(c)}{\Omega} \qquad (3.)$$

It must be noted that L is here measured in electrical measure, or adopting the unit given by Dr. Siemens in the British Association Address in Joules. One Joule equals approximately ·74 foot-pounds. Equation (3) gives at once an analytical proof of the second principle stated above, that for a given motor the current depends upon the couple, and upon it alone. Equation (2) shows that with a given load the speed depends upon E, the electromotive force of the main, and R the resistance in circuit. It shows also the effect of putting into the circuit the resistance frames placed beneath the car. If R be increased until C R is equal to E, then *w* vanishes, and the car remains at rest. If R be still further increased, Ohm's law applies, and the current diminishes. Hence, suitable resistances are, first, a high resistance for diminishing the current, and, consequently, the sparking at making and breaking of the circuit; and, secondly, one or more low resistances for varying the speed of the car. If the form of *f* (C) be known, as is the case with a Siemens' machine, equations (2) and (3) can be completely solved for *w* and C, giving the current and speed in terms of L, E, and R. The expressions so obtained are not without interest, and agree with the results of experiment.

It may be observed that an arc light presents the converse case to a motor. The E.M.F. of the arc is approximately constant, whatever the intensity of the current passing between the carbons; and the current depends entirely on the resistance in circuit. Hence the instability of an arc produced by machines of low internal resistance, unless compensated by considerable resistance in the leads.

The following experiment shows in a striking form the principles just considered. An Edison lamp, P, is placed in parallel circuit with a small dynamo machine, M, used as a motor. The Prony brake on the pulley of the dynamo is quite slack, allowing it to revolve freely. Now let the lamp and dynamo be coupled to the generator running at full speed. First, the lamp glows, in a moment it again becomes dark; then, as the dynamo gets up speed, glows again. If the brake be screwed up tight the lamp once more becomes dark. The explanation is simple. Owing to the co-efficient of self-induction of the dynamo machine being considerable, it takes a finite time for the current to obtain an appreciable intensity; but the lamp having no self-induction, the current at once passes through it and causes it to glow. Secondly, the electrical inertia of the dynamo being overcome, it must draw a large current to produce the kinetic energy of rotation—*i.e.*, to overcome its mechanical inertia; the lamp is therefore practically short-circuited, and ceases to flow. When once the rotation has been established the current through the dynamo becomes very small, having no work to do except to overcome the friction of the bearings, hence the lamp again glows. Finally, by screwing up the brake, the current through the dynamo is increased and the lamp again short-circuited.

It has often been pointed out that reversal of the motor on the car would be a most effective brake. This is certainly true; but, at the same time, it is a brake that should not be used except in cases of emergency. For this reason, the dynamo revolving at a high speed, the momentum of the current is very considerable; hence, owing to the self-induction of the machine, a sudden reversal will tend to break down the insulation at any weak point of the machine. The action is analogous to the spark produced by a Ruhmkorff coil. This was illustrated at Portrush; when the car was running perhaps fifteen miles an hour, the current was suddenly reversed. The car came to a standstill in little more than its own length, but at the expense of breaking down the insulation of one of the wires of the magnet coils. The way out of the difficulty is evidently at the moment of reversal to insert a high resistance to diminish the momentum of the current.

In determining the proper dimensions of a conductor for railway purposes, Sir William Thomson's law should properly apply. But on a line, where the gradients and traffic are very irregular, it is difficult to estimate the average current, and the desirability of having the rail mechanically strong, and of such low resistance that the potential shall not vary very materially throughout its length, becomes more important than the economic considerations involved in Sir William Thomson's law. At Portrush the resistance of a mile, including the return by earth and the ground rails, is actually about 0·23 ohms. If calculated from the section of the iron it would be 0·15 ohms., the difference being accounted for by the resistance of the copper loops, and occasional imperfect contacts. The E.M.F. at which the conductor is maintained is about 225 volts, which is well within the limit of perfect safety assigned by Sir William Thomson and Dr. Siemens. At the same time the shock received by touching the iron is sufficient to be unpleasant, and hence is some protection against the conductor being tampered with.

Consider a car requiring a given constant current, evidently the maximum loss due to resistance will occur when the car is at the middle point of the line, and will then be one-fourth of the total resistance of the line, provided the two extremities are maintained by the generators at the same potential. Again, by integration, the mean resistance can be shown to be one-sixth of the resistance of the line. Applying these figures, and assuming four cars are running, requiring 4 horse-power each, the loss due to resistance does not exceed 4 per cent. of the power developed on the cars; or if one car only be running, the loss is less than 1 per cent. But in actual practice at Portrush even these estimates are too high, as the generators are placed at the bottom of the hills, and the middle portion of the line is more or less level; hence the minimum current is required when the resistance is at its maximum value.

The insulation of the conductor has been a matter of considerable difficulty, chiefly on account of the moistness of the climate. An insulation has now, however, been obtained of from 500 to 1,000 ohms per mile, according to the state of the weather, by placing a cap of insulite between the wooden posts and T-iron; hence the total leakage cannot exceed 2·5 ampères, representing a loss of three-fourths of a horse-power, or under 5 per cent., when four cars are running. But, apart from these figures, we have materials for an actual comparison of the cost of working the line by electricity and steam. The steam tramway engines, temporarily employed at Portrush, are made by Messrs. Wilkinson, of Wigan, and are generally considered as satisfactory as any of the various tramway engines. They have a pair of vertical cylinders 8 in. diameter and 1 ft. stroke, and work at a boiler pressure of 120 lbs., the total weight of the engine being 7 tons. The electrical car with which the comparison is made has a dynamo weighing 13 cwt., and the tare of the car is 52 cwt. The steam-engines are capable of drawing a total load of about 12 tons up the hill, excluding the weight of the engine; the dynamo is over 6 tons, excluding its own weight; hence, weight for weight, the dynamo will draw five times as much as the steam-engine. Finally, compare the following estimates of cost. From actual experience, the steam-engine, taking an average over a week, costs—

Driver's wages	£1	10	0
Cleaner's ditto	0	12	0
Coke, 58½ cwt. at 25s. per ton	3	13	1½
Oil, 1 gallon at 3s. 1d.	0	3	1
Tallow, 4 lbs. at 6d.	0	2	0
Waste, 8 lbs. at 2d.	0	1	4
Depreciation, 15 per cent. on £750	2	3	3
Total	£8	4	9½

The distance run was 312 miles. Also, from actual experience, the electrical car, drawing a second behind it, and hence providing for the same number of passengers, consumed 18 lbs. of coke per mile run. Hence, calculating the cost in the same way, for a distance run of 312 miles in a week—

Wages of stoker of stationary engine ...	£1	0	0
Coke, 52 cwt. at 25s. per ton	2	15	0
Oil, 1 gallon at 3s. 1d.	0	3	1
Waste, 4 lbs. at 2d.	0	0	8
Depreciation on stationary engine, 10 per cent. on £300, 11s. 6d. ... ... Depreciation of electrical apparatus, 10 per cent. on £500, £1 8s. 10d.	2	0	4
Total	£5	19	1

A saving of over 25 per cent.

The total mileage run is very small, on account of the light traffic early in the year. Heavier traffic will tell very much in favour of the electric car, as the loss due to leakage will be a much smaller proportion of the total power developed.

It will be observed that the cost of the tramway engines is very much in excess of what is usual on other lines, but this is entirely accounted for by the high price of coke, and the exceedingly difficult nature of the line to work on account of the curves and gradients. These causes send up the cost of electrical working in the same ratio, hence the comparison is valid as between the steam and electricity, but it would be unsafe to compare the cost of either with horse-traction or wire-rope traction on other lines. The same fuel was burnt in the stationary steam-engine and in the tramway engines, and the same rolling stock used in both cases; but, otherwise, the comparison was made under circumstances in favour of the tramway engine, as the stationary steam-engine is by no means economical, consuming at least 5 lbs. of coke per horse-power hour, and the experiments were made, in the case of the electrical car, over a length of line three miles long, which included the worst hills and curves, and one half of the conductor was not provided with the insulite caps, the leakage consequently being considerably larger than it will be eventually.

Finally, as regards the speed of the electrical car, it is capable of running on the level at the rate of 12 miles per hour; but as the line is technically a tramway, the Board of Trade Regulations do not allow the speed to exceed 10 miles an hour.

Taking these data as to cost, and remembering how this will be reduced when the water-power is made available, and remembering such considerations as the freedom from smoke and steam, the diminished wear and tear of the permanent way, and the advantage of having each car independent, it may be said that there is a future for electrical railways.

We must not conclude without expressing our best thanks to Messrs. Siemens Bros. for having kindly placed all this apparatus at our disposal to-night, and allowing us to publish the results of experiments made at their works.

A discussion on this paper, to which we can at present only refer, took place, and amongst the speakers were Prof. Ayrton, Messrs. Reckenzaun, Scott Moncrieff, Shoolbred, Alex. Siemens, and Dr. Hopkinson.

The Royal Society.—The *Soirée* of the Royal Society was held on Wednesday evening at Burlington House. The programme of novelties exhibited was smaller than usual, but contained some very interesting materials. A remarkable feature was the wonderfully fine photograph of the nebula in Orion, taken by Mr. Ainslie Common with his magnificent telescope at Ealing. Vice-Admiral Selwyn's experiment with two highly insulated electrometers was very interesting as showing that, when one was charged and the other discharged, the application of light caused a leakage of the electricity of the charged instrument, which would flow over to the discharged instrument, but which it does not do without the application of the light. Fine collections of physical instruments were shown by Elliott, by Coppock, and by Hilger; Sabine's wedge photometer, Hughes' torsion balance, and Stroh's sonorous vibration apparatus, all of which have been fully described by us, were exhibited.

REVIEWS.

*Galvanic Batteries, Accumulators, and Thermo-Batteries; a Description of the Hydro- and Thermo-Electric Sources of Currents, with particular Reference to Practical Requirements.** By W. PH. HAUCK. Vienna, Pesth, Leipzig: A. Hartleben.

THE author of this treatise suspects that the modern electro-technicist may smile at the mention of galvanic batteries as something belonging to a by-gone stage of applied electricity. Still he considers that they are not undeserving of attention, especially since the secondary elements—a long-neglected form—have been found capable of varied applications. We are told at the outset that the chemical theory of the galvanic elements, as developed by Franz Exner, is accepted throughout the work, even when, for the sake of brevity, the old terms polarisation and depolarisation are used.

The author gives as introduction a brief history of the discovery of galvanism. He does not seem to be aware that the illustrious Dutch naturalist, Swammerdam, anticipated the fundamental experiment of Galvani by more than a century. As early as 1678, when on a visit to Tuscany, he showed the Grand Duke that when a portion of muscle of a frog's leg hanging by a thread of nerve bound with silver wire was held over a copper support, so that both nerve and wire touched the copper, the muscle immediately contracted. This experiment, however, attracted little notice, and, as far as we are aware, it was not followed up by its author.

After his brief notice of the first observation of Galvani, and of its explanation by Volta, the author considers the processes in the voltaic element, the cause of the electric excitement, the galvanic current and its four-fold effects. In succeeding paragraphs we find mention of the connection between strength of current, electromotive force, and resistance, also of the modification of the strength of the current by combining several elements in a battery, either in series, when the object is for tension or parallel to each other when quantity is required. The work of the current, the invention and use of the voltameter, the distribution of heat in the circuit according to Joule's law, the weakening of the current after the circuit has been closed for some time, &c., are successively discussed.

Having thus disposed of introductory and elementary considerations, Herr Hauck, in his second chapter, turns to his more especial subject, the galvanic elements. He arranges these in groups according as depolarisation takes place by the oxygen of the air, by that of metallic oxides, that of acids, and that of metallic salts.

Under the first head we find elements which contain acids as the exciting fluid, such as the original cup-battery of Volta, the column, or pile, of the same physicist, whose discs of copper and zinc stratified with slips of cloth steeped in sulphuric acid were built up between vertical and subsequently horizontal glass rods. Then follow the Cruikshank trough battery which we often see depicted in manuals dating from the first quarter of the century; the improved forms of Wollaston, with an increase in the surface of the negative electrode; the modifications of Schmidt, Murch, Faraday, and Young; the sand battery, which was at one time adopted in the English telegraph service; and the so-called calorimeter of Hare, famed in former days for its powerful, but transitory thermic action.

As the first successful attempt at constancy the author mentions the Smee battery, formerly much employed in the Austrian telegraphic service. As its chief defect is noticed the liability of the solution of sulphate of zinc to undergo decomposition when metallic zinc is deposited upon the silver plate. As an improvement figures the Tyer battery, thousands of which have been used in the English railway telegraph service. A somewhat similar arrangement is that of Ebner, who uses platinised lead in place of platinised silver.

Next follows Bunsen's discovery, which forms a turning point in the history of galvanic batteries, as introducing electrodes of carbon in place of copper, silver, or platinum, thus effecting a great reduction in working cost. Walker effected a modification in the sand battery by substituting for copper, carbon electrodes upon which platinum had been deposited. These elements were so satisfactory that 9,000 were in use in the year 1875. The zinc plunges at its lower end into a gutta-percha cup containing mercury. Böttger proposed to increase the permanence of carbon elements by saturating the carbon with nitric acid.

Poggendorff and Drive sought to improve the battery by covering the copper electrode with a deposit of pulverulent or of spongy copper. Maudet, working in a similar direction, made use of a lead plate covered with a deposit of spongy lead.

Zinc-iron elements were proposed by Sturgeon and by Münnich. The latter used amalgamated iron plates, and is said to have thus produced an element little inferior in electromotive force to that of Smee.

Iron-copper and iron-carbon elements have also been proposed, but they have not come into extended use.

Attempts have also been made to substitute some other acid for the sulphuric. Roberts constructed an element consisting of one plate of tin and two plates of platinum plunging into nitric acid. With 50 small elements of this kind he is said to have obtained an electric light. Hydrated stannic oxide was produced, which was easily converted into the stannate of soda—an article extensively used by calico printers. The nuisance due to the liberation of the oxides of nitrogen has militated against the adoption of this ingenious proposal.

In Pulvermacher's chain, which has been widely used for therapeutical purposes, the exciting fluid is acetic acid, or if magnesium electrodes are used instead of zinc, plain water.

Next follow certain elements in which saline solutions serve as the exciting fluid. Thus, in the Swiss railway telegraphs there is used a zinc-carbon element with salt water. Hipp, of Neufchatel, uses such batteries for driving electric clocks. Bagration's element is a vessel filled with earth, moistened with a solution of sal-ammoniac, and with zinc-copper electrodes.

The Maiche element claims a place of merit. Its exciting fluids are solutions of sal-ammoniac, or of bi-sulphate of soda, or in default water acidulated with 5 to 10 per cent. sulphuric acid. The negative electrode is platinised carbon surrounded by granules of platinised carbon, and placed in a perforated and porous vessel. Through this vessel descends a tube of hard rubber, to the lower end of which is fixed a platinised capsule containing mercury and fragments of zinc, forming the positive electrode. The inventor claims that this element economises 95 per cent. of the working cost of other elements, but he admits that it is best adapted for interrupted uses.

Somewhat similar is the element of Karl Satory. The element of Stoehrer and the elements of Lagrange, Brett, and Little, in which sulphuric acid falls in drops into the zinc cell, do not require any extended notice.

Among elements with one liquid and a metallic oxide rank De la Rive's arrangement, in which the negative electrode of a Smee element is coated with peroxide of lead, and the well-known Leclanché, or manganese element, which is in very extensive use. Amongst the main advantages are its small consumption of zinc and its efficiency at low temperatures. It is most serviceable for interrupted use and for a considerable resistance, as in the telegraphic service.

Among dry elements the most prominent place belongs to that of Zamboni, which is still used in electroscopes.

Of the elements in which depolarisation is effected by the oxygen of acids, the most prominent places belong to the Grove and the Bunsen, both of which employ two acids, sulphuric in contact with the zinc, and nitric in contact with the negative electrode. Faure modifies this principle by making the carbon element hollow and filling it with nitric acid. The Tommasi element is very similar to the Bunsen, but the positive electrode is of aluminium. The Callan battery of iron and zinc, the former metal in contact with nitric acid, is extensively used in Austria.

Various elements require chromic acid as exciting fluid. Such are employed in the telegraphic service both in England and Germany, and are preferable to the Leclanché where the work is heavy.

Among the arrangements where depolarisation is effected by the oxygen of metallic salts, ranks firstly the Daniell element, which has undergone many modifications. Of these, perhaps the most important is the Meidinger, much used in the electrolytic analysis of metallic compounds.

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* *Die Galvanischen Batterien, Accumulatoren, und Thermosäulen. Eine Beschreibung der Hydro- und Thermo-elektrischen Stromquellen mit besonderer Rücksicht auf die Bedürfnisse den Praxis.*

Less important classes of elements are those which consist of a gas and a liquid or of two gases.

Among secondary elements the author describes the celebrated accumulators of Planté, Méritens, Sellon, Changy, Kabath, Faure, Schulze, Arsonval, Böttcher, and Sutton, and the accumulators of Houston and Thomson, without lead plates. The author points out that accumulators are much more easily charged by magneto-electric than by dynamo-electric machines.

The last section of the work is devoted to thermo-electric combinations.

From the short sketch which we have given of the contents of this book the reader will be able to form but little idea of its completeness. Numbers of elements, which space did not allow us to mention, are described, and in many cases figured and their defects and advantages pointed out.

M. TROUVÉ'S BICHROMATE OF POTASH BATTERY.

[Results of experiments made by M. E. HOSPITALIER upon two batteries of six elements.]

EACH battery consists (fig. 1) of an oak box, containing six rectangular troughs of ebonite, which contain the liquid of each element. The zincs and carbons, connected together by movable couplings, are mounted upon a frame which allows of varying, at pleasure, their immersion in the liquid, and of thus regulating the delivery by altering the internal resistance of the battery and its active surface. Lastly, a wooden stop prevents the elements from completely leaving the troughs; but by removing this stop or by pushing it aside the height of the frame allows of making them quite independent, so that the ebonite troughs may be readily emptied or refilled. The front of the box is provided, for this purpose, with a hinge by which it may be opened and the troughs removed without disarranging the elements.

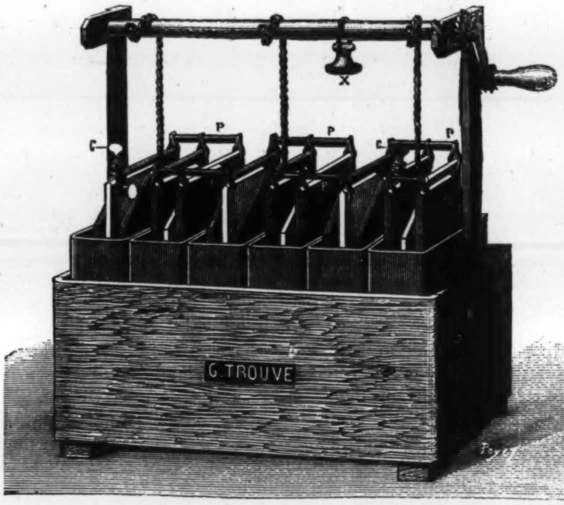


FIG. 1.

The elements are formed of a plate of zinc and two carbons electro-coppered at the upper part. The zinc has a notch which serves to fix it to the metallic couplings covered with india-rubber, which supports the elements. This arrangement enables the zincs to be quickly removed for amalgamation or replacement. The composition of the liquid for a battery of six elements is as follows :—

Water	8	kilogrammes.
Pulverised bichromate of potash ...	1·2	,,
Sulphuric acid	3·6	,,
Total	12·8	

The solution contains, therefore, 150 grammes of bichromate of potash per litre of water instead of 100 grammes, as in the formula given by Poggendorff.

For a more rapid delivery M. Trouvé increases the quantity of bichromate and dissolves from 200 to 250 grammes per litre of water.

This is how he prepares the solution :

He throws into the water powdered bichromate of potash at the rate of 150 grammes per litre of water ; after having agitated it, he adds, by means of a fine strainer and very slowly, 450 grammes of sulphuric acid per litre, or a quarter in volume ; the liquid mixture heats little by little, and the bichromate once dissolved remains limpid and does not deposit by crystallisation on cooling. The preparation takes eight to ten minutes. Care must be taken not to use a wooden agitator, as this would be rapidly carbonised, weakening uselessly the solution.

The medium weight of a battery of six elements is thus divided :

6 zincs	7·680	kilogrammes
12 carbons...	5·460	,,
6 ebonite troughs...	1·620	,,
Contacts	0·600	,,
Oak box	3·000	,,
Iron standards	2·300	,,
Liquid	12·800	,,
Total weight	33·460	

or 67 kilogrammes for the two batteries.

RESULTS OF EXPERIMENTS.

The 12 elements connected in series were discharged through six Swan lamps in derivation. The delivery was regulated by manipulating the frame of each battery so as to maintain a constant current of eight ampères during four hours and a half. At the moment of immersion the great initial electromotive force of each element produced a current of 12 ampères, although the zincs were only plunged in about two centimetres. After a few minutes the current returned to its normal strength of eight ampères. The slight heating of the liquid then caused a slight increase of consumption, which became normal 15 minutes after the starting. The battery worked in these conditions for an hour and a half without necessitating the lowering of the zincs. From this moment the decreasing delivery was compensated by gradually increasing the immersed surface. The variation never exceeded half an ampère and the mean current was very carefully kept at eight ampères during four hours and a half, after which time the zincs were completely immersed to a depth of about 15 centimetres in each element. From this time the decrease was very regular and the experiment stopped by raising the zincs when the current had reached five ampères. (See the discharge curve, fig. 2.)

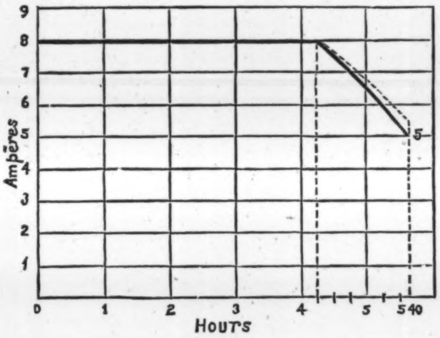


FIG. 2.

The discharge was, therefore, divided into two phases :

1st Phase. The delivery maintained constant at eight ampères during four hours and a quarter.

2nd Phase. The delivery decreasing regularly from eight to five ampères during one hour and twenty-five minutes.

1.—*Constant Phase.*

Difference of potential at terminals of lamp ...	14·15 volts
" " " batteries	16·70 "
Intensity of current	8 ampères
Disposable electric energy in external circuit ...	133·6 watts
" " " ...	13·5 kilos. per second
Duration of constant phase	15,300 seconds
Quantity of electricity furnished...	122,400 coulombs
Total disposable electric energy in external circuit	206,550 kilos.

2.—*Decreasing Phase.*

During this second phase the mean current was 6·55 ampères during one hour and twenty-five minutes, or 5,100 seconds, and the mean disposable electric energy in the external circuit 9 kilogrammetres per second.

Total Work.

When we totalise the two phases which represent the actual delivery in the conditions of the experiment, we obtain the following results:

Total quantity of electricity furnished—156,000 coulombs.

Total disposable energy in the external circuit 253,350 kilogrammetres.

The H. P.-hour or 1,980,000 foot-pounds being equal to 270,000 kilogrammetres, these figures show that the two batteries furnished together 0·96 H. P.-hours, or practically ½ H. P.-hour per battery of 6 elements.

Five batteries of 6 elements, that is to say, 30 elements in series would suffice to supply an arc lamp burning carbon 9 millimetres in diameter, with a current of 7 ampères and 40 volts difference of potential at the terminals of the lamp during five hours.

Consumption of zinc.—The zincs weighed before and after the experiment indicated a consumption of:

For the first battery	751 grammes.
" " second "	712 "
Total ...	1,463 "

or on an average 122 grammes per element. The minimum consumption was 105 grammes and the maximum consumption 133 grammes. The theoretical consumption, deduced from the quantity of electricity and the electro-chemical equivalents is 53 grammes per element, or 636 grammes for the two batteries.

It follows from these experiments that two batteries of 6 elements each, newly charged, represent a disposable electric energy of 1 H. P.-hour or 270,000 kilogrammetres, with a weight of not more than 67 kilogrammes. It is important to notice here that no arrangement has been made from the point of view of lightness, and that it would be easy to reduce this weight to 50 kilogrammes. This figure is said to be lower than accumulators have been able to furnish up to the present time.

The consumption is represented by the following figures:

Zinc	1,460 grammes.
Bichromate	2,400 "
Sulphuric acid	7,200 "

These figures allow of calculating easily what is the price per H. P.-hour of disposable electric energy with M. Trouvé's batteries when we place them in the usual conditions of delivery of which the results are given above.

What is Carbon?—M. Berthelot, in the *Journal de Pharmacie et de Chimie* for March, states that from peculiar physical relations he is led to suspect that the true element carbon is unknown, and that diamond and graphite are substances of a different order. Elementary carbon ought to be gaseous at the ordinary temperature, and the various kinds of carbon which occur in nature are in reality polymerised products of the true element carbon. Spectrum analysis is thought to confirm this view; and it is supposed the second spectrum seen in a Geissler tube belongs to gaseous carbon. This spectrum, which has been recognised along with that of hydrogen in the light of the tails of comets, indicates a carbide, probably acetylene.

MR. STROH'S MICROPHONIC EXPERIMENTS.

During the discussion which followed the reading of Mr. Shelford Bidwell's paper on Microphonic Contacts at the Society of Telegraph Engineers and Electricians on the 12th inst., Mr. Stroh gave an account of the following experiments:—

The microphone used was again of the hammer-and-anvil pattern, this form being most suitable for experiment.

On a little board, A, fig. 1, was fixed by means of a brass holder, *a*, a thin carbon rod, *b*. Against the end of the latter rested loosely another carbon rod, *c*, which was mounted on a little spindle, *d*, and a small spiral spring, *e*, served to vary the pressure at the contact between the two carbons, *b* and *c*.

FIG. 1.

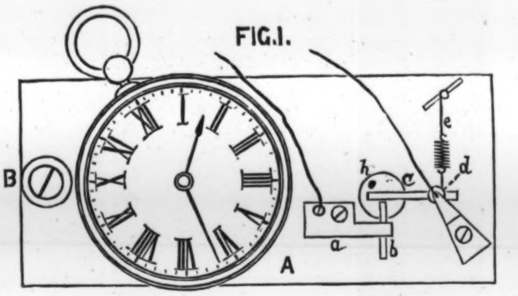


FIG. 2

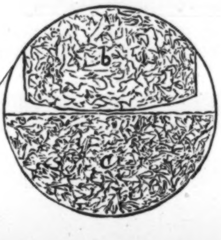
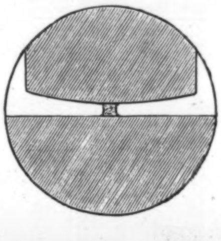


FIG. 3



The object of this arrangement was that the points of contact might be brought under a microscope, and for that reason the carbons, where they came into contact with each other, were made as flat as possible and also thin at the edges, so that they might be fairly brought into the focus of the microscope.

The little board, A, on which was placed a loud ticking watch as a source of sound, was fixed at B on a stand apart from that of the microscope, so that touching and adjusting the latter might not interfere with the microphone. A hole in the board at *h*, under the contact, is necessary to admit light from below.

In the circuit with the microphone were a telephone, a make-and-break key, and a small battery of 1 to 3 cells.

The two edges of the carbon contact appeared, although they were made with care, rough and jagged through the microscope, as represented in fig. 2, and before the current passed one or two of the projecting points were seen in contact only.

The tension of the spring for the first observation was such as was known by experience to be necessary to insure microphonic contact. By depressing the key a current from two cells was now sent through the circuit, and the effect was closely observed by means of the microscope. What was noticed was a light, or in fact a burning away of the carbon; the two carbons came closer together during that burning, and presently another contact was made and another light became visible. The carbons still approached until three or four points were in contact, each of which was illuminated, and at last, as it appeared, when there were a sufficient number of points of contact for the greater portion of the current to pass, then the burning ceased and the ticking of the watch could be heard in the telephone.

All this took place in the course of a few seconds, and while the microphonic condition remained no light could be seen at the point of contact. But as soon as the battery power was increased the burning commenced again, and continued until the area of contact was sufficiently enlarged, and consequently the resistance so far reduced that the degree of heat which was still produced was below that which causes the combustion of the carbon.

This agrees with Mr. Bidwell's observation, viz.:—That the resistance of the contact falls with an increase of current.

The pressure at the contact was now reduced to a minimum by letting down the tension-spring so that the two carbons were only just in contact and no more, and when a current from the two cells was allowed to pass a momentary burning at the contact, accompanied by a click in the telephone, was observed; then followed an interruption and the current would pass no more.

By making contact with the key many times no trace of current could be detected with the telephone, showing that after the first passage of the current great resistance was established. This is also an effect observed and investigated by Mr. Bidwell.

The tension-spring was now slightly tightened; this evidently caused the insulating film or substance, which prevented the current from passing, to be forced aside or broken through, for another current passed on making contact, but only for a moment, and then again an interruption occurred. This could be repeated several times, until the spring was wound so tight that the insulating substance was broken through as soon as it was formed, and then the well-known boiling or hissing noise, which we hear when the microphone is out of adjustment, could be heard in the telephone. Sometimes the noise was a perfectly clear musical note, and by adjustment of the spring it occasionally became as shrill as a whistle.

It was found possible to adjust the microphone so that while still listening to the noise the watch could be heard as well, and whenever this was successfully accomplished the tick of the watch was heard louder than under any other circumstance.

That experiment was made with a telephone of considerable resistance, which was now replaced by one of a very small resistance, only a few ohms, and an entirely different effect was obtained.

The spring was again let down so that the carbons were only just in contact. A momentary burning was seen as before on passing the current, but the movable carbon was also driven away from the fixed carbon and apparently remained repelled at some distance. Each time the circuit was completed by the key the movable carbon was driven away, and a continuous stream of sparks could be seen flying across the space.

The sound produced in the telephone by this effect resembled the crackling of burning wood. By tightening the spring the noise was frequently changed into a musical note, the pitch of which rose with the pressure.

By closer observation exceedingly fine dark lines could be seen, which reached from every projection of the jagged edge of the loose carbon right across the space to the fixed carbon. This showed that the movable or loose carbon was in a state of vibration, the amplitude of which was equal to the distance of the apparent separation of the two carbons.

This distance, which was considerable when the rate of vibration was low, became rapidly less as the rate was increased by tightening the tension-spring, and a point was soon reached when the separation could no longer be seen but was likely still to exist during the production of the higher sounds.

Another effect which was occasionally observed with the microscope during the production of the various noises abovementioned, was that little fragments of carbon, which probably became detached by their expansion by heat but still remained between the electrodes, were in a state of agitation.

There can be no doubt that during the production of these singing, hissing, or boiling noises, the current cannot be a constant one, but that in the case of the former it must be intermitted and of equal periods, while in the case of the latter it is probably undulatory and of unequal or irregular periods.

It also appears evident that a current crossing a microphonic contact has a strong tendency to cause vibratory disturbances, and it seems therefore reasonable to suppose that during microphonic action, even when all is in good adjustment, the sound waves which are transmitted are accompanied by other vibrations which are due to the passage of the current itself.

The following reasoning has led to this supposition. Whenever it was possible to adjust the microphone so that the ticking of the watch could be heard during the production of singing or hissing noises, the timbre or quality of the sound of the ticking was exactly that of the hissing noise, and any change in the character of the latter was always accompanied by a corresponding change of the former.

It being a fact that sudden slight changes in the quality of sound are sometimes observed, even when the adjustment of the microphone is perfect, that is to say, when no singing or hissing noises are heard, it must be that whenever soundwaves are transmitted these have superimposed upon them other vibrations, possibly of a very high rate or pitch, which vary and so produce change of timbre or quality. The latter would be the vibrations or disturbances produced by the passage of the current across the contact.

In the next experiment metallic contacts were substituted for the carbon ones. With platinum very good microphonic effects have been obtained whenever sticking could be avoided.

With a view to prevent sticking, a little oil was placed on the platinum contacts, but quite a different and unexpected phenomenon was observed. The oil by its capillary attraction remains surrounding the contact, and when the adjustment was so that the ticking of the watch could be heard, little particles of dust or carbon which happened to be in the oil were seen in violent agitation, and to be spinning round with great rapidity.

It was puzzling for a time as to what caused these particles to be agitated in so violent a manner, but it appeared afterwards that it was probably the effect of heat. The oil seemed to be boiling at the point of contact, even with a single cell, and when an exceedingly fine thread of smoke was observed arising from the contact it was concluded that such must be the case.

A number of carbon particles were then placed upon the oil, and when the current was again sent through and allowed to continue for a minute or so, the whole of the carbon dust which was at first violently rotated and started in all directions, accumulated by degrees round the point of contact and at last built up a pillar, which forced the electrodes wide apart and took the shape shown in fig. 3.

Steel contacts were now substituted for platinum, and with them the same experiments turned out equally successful, but another curious phenomenon was observed: the black particles in the oil continued their movements for a considerable time after the current had been interrupted by the key. In some cases it took quite two minutes before they came entirely to rest.

Having also ascertained that a pillar could be formed with and without the carbon dust in the oil, the latter was now taken away altogether, and it was found that by a little humouring a pillar could be caused to grow even when the contacts were perfectly dry and clean.

This pillar while in course of formation had the appearance of being in a state of low incandescence, but it was concluded afterwards that it was only surrounded by a dull red glow, which appeared to be really a succession of sparks running along the surface of the pillar.

In concluding his remarks, Mr. Stroh said that he did not think at present that the formation of the pillar was directly connected with microphonic action, but he regarded it more as a secondary effect. He deemed it advisable, however, that all observed effects should be recorded, and that by collecting and compiling them we may help in time to unravel the mystery which still clings to microphonic contacts.

Italian General Exhibition.—This exhibition is fixed to take place in Turin, from April till October next year, and to it foreign producers for the classes which refer to electricity will be admitted. "If there is a country," says the committee, "where industry can cherish great hopes on the applications of electricity that country is Italy, which, being now compelled to import from abroad all the coal for steam-boilers and for gas-lighting, sees for the future in the water-falls and in the torrents of its Alpine valleys an inexhaustible source of motive power."

THE EXPERIMENTS OF TRANSMISSION OF POWER AT THE CHEMIN DE FER DU NORD.

The committee appointed by the Académie des Sciences at its meeting of the 19th February, presented a report on the 9th April. This committee was composed of MM. Bertrand, Tresca, De Lesseps, De Freycinet, Cornu, and a reporter.

We will summarise the principal points, not without some necessary reserve, justified by the not too optimistic concluclusions of this report.

After having shown the importance of the problem of the transmission of power to a great distance, the reporter gives a very interesting description :—

"As is the case with most great modern industrial progress, it is in the scientific laboratory that we find the origin of this important question ; the first example of transmission of power to a distance was, in fact, accomplished by Faraday. By pushing the inducing magnet into the induced bobbin, Faraday deflected the needle of his galvanometer, the effort of his hand produced, therefore, at some metres distance, an effort upon the needle by the intermediation of an electric current, a feeble effort, it is true, but one which is truly the germ of all ulterior progress.

"Gauss and Weber increased the distance of transmission and the amount of effort. To-day we seek to transmit to several hundreds or thousands of metres motive force of useful power ; and, moreover, we require that the operation be economical. This is, in fact, what constitutes the difficulty of the problem, of which the three characteristic terms are :—

"1. To transport by means of the electric current a considerable quantity of energy ;

"2. To transport it to a great distance ;

"3. To do this in such a way that the first cost (relative to the amount of energy transmitted) of the machines and conductors may not exceed a certain value.

"These three terms are equally important ; for, if we suppress one of them, the difficulties disappear, the problem becomes simple, if indeed not solved a long time ago.

It seems that we ought to add, as a fourth term, a condition to which mechanicians generally attach great importance, namely, that the rendering, that is to say, the ratio of the work transmitted to the work expended, should be as high as possible.

"In the special conditions of which the problem of the transmission of power is found, the question of rendering is only accessory, for it is generally required to utilise forces at present useless owing to the remoteness of their source ; therefore, however low the proportion utilised, provided it is not at a loss, the result will be always advantageous. Nevertheless it is obvious that the solution of the problem will be the more complete as the rendering obtained is higher."

Laying aside the history of the question from an industrial point of view, the reporter proceeds to give an account of the experiments in which the Committee took part on March 4th at the works of the Chemin de fer du Nord. He recalls the singular arrangement of coupling of the machines and replies in these terms to the objections raised against this particular method of connecting.

"This arrangement offered the advantage of placing the two machines side by side, and of greatly faciltating simultaneous measurements ; it differs, it is true, from the conditions imposed in the transmission of power to a great distance, by reason of the direct junction of the machines, an objection might, therefore, be raised against this method of experiment.

"We know, in fact, that the testing of telegraphic apparatus, under the conditions of joining of these two machines, would allow of no conclusion upon the value of the apparatus from the point of view of its working along the line, that is to say upon the rapidity of working ; but this objection diminishes considerably if we notice that telegraphic signals are characterised by the discontinuity of the currents, a discontinuity which the electrical capacity of long lines, the electrification of insulators, &c., tend to efface and destroy ; this is why telegraph wires cannot be, from the point of view of the delicacy of apparatus, replaced by a short wire of equal resistance. But, for the transmission of a uniform current, these difficulties do not exist, for it is only necessary to know whether the electrical flow traverses without complications the given circuit, of which we have had numerical proof in each experiment ; the objection derived from comparison with telegraphic apparatus, therefore, loses the greater part, if not the whole, of its value.

"It would have been quite different if the current used had been alternating, as in certain machines serving for the production of light ; therefore the committee, without regarding this objection, has, with certain reservations,* accepted the conditions offered, and examined in detail all the elements which it was possible to observe."

We take the liberty here of differing entirely from the opinion of the worthy reporter. Discontinuity of the currents, the electrical capacity of the line and the electrification of the insulators have nothing to do with the matter, since the current is continuous, or practically so. The difficulties and complications owing to the derivations of the line are independent of the continuous or alternating character of the current, and we confess that we do not understand why an appreciable loss for a current of short duration should cease to be so in a continuous current, especially when the potential exceeds 2,000 volts. We think this is a case to recall the experiments of Schwendler, of which we can read an analysis in a journal not calculated to furnish us with arguments, *La Lumière Electrique*, the first half-year, 1881. We find there some very conclusive experiments upon the influence of derivations, not with rapidly interrupted, but with continuous currents. The current, measured on arrival, varied between 9-10ths and 1-5th of its value on departure, upon very long lines, it is true, but also with potentials lower than 200 volts.

These experiments prove that derivations exist, and that we have no authority, by a reasoning of a correctness more than contestable, to make their influence equal to zero *without having made a single experiment*, when anterior experiments prove that these derivations are *very important* upon long lines, and with continuous currents of two hundred volts potential.

We shall return shortly to the assertion that the electrical flow traverses, without complications, the given circuit, numerical proof of which was obtained in each experiment.

We understand that the Committee has accepted the conditions offered, with certain reservations, as mentioned in the report.

We shall lay aside all the calculations and co-efficients of reduction relative to the defects of the instruments of measurement, in order to examine the dynamometrical results given in the table below :

Dynamometrical Results.

No. of the Experiment.	Number of Revolutions per minute.		Mechanical Work				Dynamometrical rendering.	
			furnished					
	Generator.	Receiver.	by the pulley of the dynamometer.	at the generator.	received at the brake of the receiver.	transmitted per revolution of the generator.	actual.	transmission deduced.
	N	n	T	Tm	Tu		$\frac{Tu}{T}$	$\frac{Tu}{Tm}$
			H. P.	H. P.	H. P.	H. P.		
I.....	378	104	3·838	3·296	0·578	0·00153	0·151	0·176
II.....	370	88	3·854	3·331	0·489	105	0·127	0·147
V.....	850	602	9·771	7·665	3·344	393	0·342	0·435
VI....	923	709	10·556	8·259	3·939	427	0·372	0·477
VII.....	850	643	9·514	7·408	3·572	420	0·375	0·482
VIII.....	1024	799	12·267	9·731	4·439	433	0·362	0·456

"An inspection of this table shows that the work absorbed by the generator and transmitted to the receiver increased with the speed of the generator.

The principal fact is that we have succeeded in the transmission of nearly 4½ H. P. through an effective resistance of 160 ohms, representing a double telegraph wire of 8·5 kilometres length.

---

* A desire was expressed by one of the members to establish an earth contact in place of the short wire connecting the two machines ; it would have been, certainly, very interesting to compare the results obtained with or without this earth contact, which would have considerably modified the distribution of potentials in the circuit without altering theoretically the intensity of the current ; we should have had, moreover, a control of the insulation of the line ; material difficulties—not considering the danger which would result to the persons called upon to touch imperfectly insulated machines—prevented the realisation of this scheme. We shall see, besides, further on that the electrical determinations bear in each experiment a satisfactory verification of the working of the telegraph wire.

As for the approximate rendering it represents 37½ per cent. of the work expended, this is the figure which we may adopt if we wish to allow to some extent for the losses which are sustained in the working of any motive machine, whatever motor is employed. If, on the contrary, we wish to neglect the mechanical motor in order to consider exclusively the result produced by the successive transformations of energy, we may say that the dynomometrical rendering exceeded 48 per cent.

The discussion of the figures of the table would seem to indicate that, if the quantity of work transmitted continues to increase with the speed of the machines, the maximum rendering is obtained with the speed of the generating machine at about 850 revolutions. This conclusion deduced from too few results, would be unimportant except that the experiments of the 18th February lead to the same conclusions.

We point this out, in passing, in order that ulterior studies may confirm this conclusion, which does not agree with what is generally thought on this subject. Moreover, we will observe that the quantity of work transmitted increases more than proportionally to the speed of the generator, but approximating towards the proportionality.

This remark tends to demonstrate that the generator has not yet reached the maximum of its effect, and that a more rapid rotation would allow of transmitting a considerably greater quantity of work.

The experiment besides confirms, in another form, this idea: at these high speeds of the generator, the receiver used, which was an old form of Gramme machine modified, appeared to have attained its maximum of transmission. Its brushes were the seat of continual and extremely brilliant sparks, and often circles of fire suddenly surrounded the whole of the periphery of the shaft; the machine was, so to speak, saturated, and there was danger of destroying it by imposing a more considerable electric work upon it. The generator worked, on the contrary, much more regularly; the sparks at the brushes were feeble; it is therefore very probable, according to the opinion of M. Deprez, that a more considerable transmission and a greater rendering would have been obtained if there had been arranged as a receiver a machine identical with the generator.

Electrical Results.

No. of Experiment.	Number of revolutions per minute of the generator.	receiver.	Intensity.	Difference of potential at the terminals of the generator.	receiver.	Effective resistance of the telegraph wire.	Total electromotive force developed in the generator.	receiver.	Electric rendering.
	N	n	I	U	u	$\frac{U - u}{I}$	E	e	$\frac{e}{E}$
			amp.	volts.	volts.	ohms.	volts.	volts.	
I.......	378	104	2·39	722	321	167	855	116	0·136
II.	370	88	2·52	745	355	155	888	138	0·155
IV. . . .	923	709	2·52	2,086	1,685	159	2,229	1,468	0·658
VII. ..	850	643	2·57	1,937	1,479	179	2,083	1,258	0·604
VIII...	1,029	799	2·50	2,338	1,994	138	2,480	1,779	0·717
				Mean value		159·6			

The first thing which this table proves is that the telegraph wire showed during the transmission of power, that is to say, with a current of nearly 2·5 ampères, a resistance of 160 ohms, which was the same as that with a current of 0·01 ampère in previous experiments. This is shown by the column headed "Effective resistance of the telegraph wire," obtained by dividing the intensity, I, by the difference U — *u*, which represents the difference of potential at the extremities of the line; the mean of the results, 159·6, coincides with the figure 160, determined many times.

The partial divergence of the results is due to the inevitable variation of speed of the machines, and especially to the impossibility of making the measurements of U, *u*, and I absolutely simultaneous.

This identity between the effective resistance of the line and the measured resistance is very important from the point of view of the accordance between theory and experiment in analysing the phenomena of the transformation of energy in the circuit. It shows that the consumption of energy necessary to overcome the resistance of 160 ohms is practically exactly equal to the value assigned by theory. This amount of energy expressed in kilogrammetres per second is equal to $\frac{\rho I^2}{g}$ and in H.P. $\frac{\rho I^2}{75\,g}$. As the intensity of the current remained practically constant and equal to 2·5 ampères, the loss of mechanical work is equal, during the entire series, to about

$$\frac{160 \times 2{\cdot}5^2}{75 \times 9{\cdot}81} = 1{\cdot}358 \text{ H. P.}$$

We know that this amount of energy is disseminated in the form of heat."

The report seems to attach a great importance to the apparent constancy of the effective resistance of the telegraph wire. In reality nothing was less constant than this resistance in the experiments of the 4th of March, and by a singular coincidence (but difficult to explain), in experiment vii. (that which gave the greatest rendering) the resistance of the line was 179 ohms, that is to say, 19 ohms more than the actual resistance.

The variations attained a quarter of the absolute value of the resistance, for there is a difference of 41 ohms between the resistances deduced from the experiments vii. and viii. (See Table of Electrical Results.) The most grave objection is this: even if the figures had indicated slighter differences than those which we point out, we should not be authorised by that to conclude that the derivations would be without influence in direct transmission with the machines at each end for this reason.

With the metallic loop the greatest difference of potential between any two points of the line has never been higher than 400 volts, whilst if the machines had been placed at a distance this maximum difference of potential might have reached 2,338 volts (see experiment viii.) near the generator, and 1,994 volts near the receiver. Are the losses in these two cases comparable? We think not, and all the reasoning in the world would be powerless to make us accept it so long as not one *direct* experiment proves the contrary. The identity between the effective resistance and the measured resistance of the line so important, according to the report, from the point of view of the accordance of theory and experiment may, with certain reservations justified by the omission of direct measurements, be accepted for this mode of connecting, but could not be considered correct for transmission on a line without contrary experimental proof.

In speaking of the progress which has been realised by M. Marcel Deprez in the construction of the machines, the report points out that his efforts have been directed in the way of increasing the power of the inductors; he has endeavoured to obtain inductors of which the magnetic field, with an equal expenditure of energy and with feeble intensities is considerably in excess of that in a machine of the same weight known up to the present.

This favourable opinion is accompanied by a calculation of which it is impossible to verify the correctness for want of all the elements of the problem, among others the mean diameter of the external layer of wire which enter into the formula given by the reporter. Without wishing to dispute the correctness, we will remark, however, that the Gramme machine employed by M. Marcel Deprez is a Gramme machine modified by him, and that there is a certain ingratitude in decrying a machine which served as the base of the perfections of which he is the author, and which has received modifications of which the primitive type would not have been thought susceptible. The comparison of a generator with two rings and two magnetic fields, and a receiver with a single ring, seems to us also very difficult to understand, especially when we do not possess all the elements necessary for this appreciation, as is actually the case.

It only remains now for us to quote literally the conclusion of the report:—

"The employment of this high electromotive force presents some very serious difficulties and requires great care, not only for the safety of the persons appointed to manipulate the apparatus, but for the preservation of the machines themselves; indeed, when the resistance of the circuit or the speed of a machine varies suddenly, the intensity of the current acquires an enormous value; the heat developed may destroy the insulation and render the machine useless. Also it is necessary for starting or stopping the apparatus to take special precautions, such as the introduction or suppression of auxiliary resistances.

"There remain therefore important questions to be solved in order to render easy and to some extent automatic the use of these machines; it is right to add that Mr. Deprez is busy solving these difficulties, and has contrived several ingenious arrangements which simplify all these manipulations.

"In conclusion, the results obtained by M. M. Deprez, conformable in every respect to the theoretical principles adopted by engineers, considerably surpass anything which had been previously accomplished in the amount of work transmitted compared with the resistance of the transmitting conductor and, moreover, are remarkable for the mechanical rendering obtained.

"The machine which he has invented and constructed is very perfect compared with those which have been up to the present constructed for the same purpose; and would probably have given still more advantageous results if a second could have been constructed to form the receiver.

"The Commission is unable to estimate the economical value and the industrial future from the results obtained; but after minute examination of the apparatus and of the principles involved, it does not hesitate to proclaim the importance of the facts which it has itself proved.

"Consequently, it recommends the Academy to congratulate M. Marcel Deprez on the important progress which he has made in the solution of the interesting problem of the electrical transmission of energy and to encourage him to pursue his labours, continuing to devote, as hitherto, the resources of an ingenious mind to the service of the best established principles of electrical science."

The conclusions of the report were proposed and adopted.

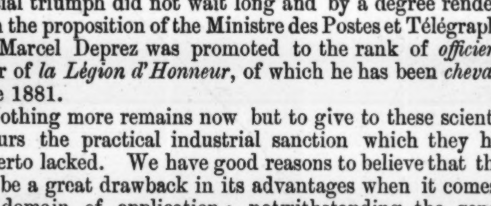
The academical triumph could not be more complete. Official triumph did not wait long and by a degree rendered upon the proposition of the Ministre des Postes et Télégraphes, M. Marcel Deprez was promoted to the rank of *officier* in order of *la Légion d'Honneur*, of which he has been *chevalier* since 1881.

Nothing more remains now but to give to these scientific labours the practical industrial sanction which they have hitherto lacked. We have good reasons to believe that there will be a great drawback in its advantages when it comes to the domain of application; notwithstanding the general rejoicing, we preserve our pessimism until the day when we see $4\frac{1}{2}$ H. P. effectively transmitted over a *true* aerial iron telegraph wire of four millimetres diameter to a *true* distance of $8\frac{1}{2}$ kilometres, with a mechanical rendering of 48 per cent. and without loss by derivation upon the line. On that day we will confess publicly our error and sound the triumphal trumpet which seems to us at present used rather prematurely.

ELECTRICAL RAILWAY SIGNALLING.

L. MORS SYSTEM.

WE know the difficulty of making a good electrical contact when it is to be worked by a train running at a high speed, and that this contact is exposed to all kinds of atmospheric changes with scarcely any attention. It is to meet the requirements of a contact of this kind that M. L. Mors has invented the contact represented below, of which the principle and disposition are easily understood by reference to the description which accompanies the figure.



It consists in utilising the vibrations produced by the passage of the train upon the rail to which it is fixed, to produce, by the movement of the mercury, a contact, in a hermetically closed space, which continues during the passage of the train. The contact works any apparatus whatever—bell, signal, disc, &c.

Experiments made upon the Paris-Lyon-Mediterranean line have given satisfactory results. The apparatus may be applied in any case where it is required that any mechanical vibration shall cause automatically a corresponding signal.

A. Lever, bent at the end to be riveted to the fishplate.

B. Contact cone, insulated from the iron box by a piece of ebonite or wood, upon which is a small plug, which is removed to replenish the mercury in the cup, if necessary. The large surface of the cone is about 2 mm. from the surface of the murcury in a state of repose.

C. Cup containing mercury. This cup communicates with the rail by the lever, and forms the "earth" pole (copper or zinc according to position).

D. Small screw for regulating height of mercury, also for emptying the cup.

E. Nipple through which is forced the junction cable, covered with a thick india-rubber tube; upon this tube is placed another tube, which covers the nipple in such a manner as to form a hermetically closed joint.

F. Iron cup containing mercury.

TO CORRESPONDENTS.

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CORRESPONDENCE.

The Prospects of Electric Lighting.

In the ELECTRICAL REVIEW of April 21st Mr. W. Kingsland commented to a certain extent upon my letter under the above heading, of April 14th, but in no way has he disproved in the slightest degree the truths and facts I there stated. Your correspondent makes an assertion which will be difficult for him to prove, viz., that I am ignorant of what is going on in the electrical world, or that I ignore facts which are patent to every careful observer.

It so happens that I am not a disappointed shareholder, nor, as your correspondent seems to imply, one of the outside public, but an actual maker of electric light machinery, and thus well understand what difficulties have to be overcome in connection with electric lighting, and other items in the construction of dynamo-electric machines from the time of Wilde's machine of 1866.

If your correspondent thinks that the public are *not* anxious to see results, what does he think they are anxious to see, when he says *probably* 99 per cent. subscribed their capital because they expected a profitable return. This is undoubtedly true, and the remaining one might be included also. I do not think for a moment that they subscribed their capital for would-be electricians to experiment with and fritter away in the manner that it is by many of the electric light companies.

The *real* cause, and main one, that accounts for the public subscribing their capital in the liberal way they did was the great inducements and promises held out by the unscrupulous speculator and company promoter, many of whom engaged themselves in a business that they knew nothing about whatever, their only object being to make a large sum of money out of the public, and then to slide out of the undertaking. What cared these men about electric lighting?

The then chairman of one of the electric light companies told me personally one evening, after visiting the Ferranti machine under Cannon Street Station, that "he did not believe that incandescent electric lighting would *ever* equal coal gas in its practical application," yet this man was receiving, what I should consider under the circumstances, a large share of ill-gotten gains. How can electric lighting progress if chairmen and directors are composed of men of this class.

I now think more than ever that the public that did invest their money in the electric lighting project have very great cause for complaint, since your correspondent has told us that the chief part of the work done during the last twelve months has been in *experimenting*. It is pretty well certain that had the public twelve months since been told that their money would be spent in experiments they would not have subscribed a single farthing. They were told by the prospectuses that the promoters had a certain system; this system was so and so, and was capable of yielding so and so. We all know that the result has been anything but what was held out twelve months since, neither is it but poor consolation to be told, as your correspondent states, that time has been spent to instruct and weed the staff, "that bad workmen have fallen out of the ranks and the good ones have been retained." If this is true with the company your correspondent represents it is not so true with many others, for even the trained men have been discharged in very large numbers, within the last three months, from electric light companies, and this alone goes very much to prove that the marked progress of electric lighting is not altogether what your correspondent would like to make us believe.

He also says that the "actual sale of plant has been limited;" then where is the business that has been done? the lighting of ball-rooms and *soirées* can scarcely be looked upon as very profitable undertakings.

Your correspondent also says "the public are very generally in favour of the new illuminant;" this I contend also; but he also says in another part of his letter, "I do not think that the public are so anxious for results as your correspondent imagines." He also states that "none of the companies have sufficient capital to establish more than one or two such central stations."

They did have sufficient capital a short time since to prove to the public over and over again that they could do what they undertook; if they have not sufficient capital *now*, it is very possible that they will never get it.

When we take into account that very many small gasworks have been started and worked on a capital of £12,000, and have paid and do pay a dividend of 10 per cent., and now are told (after hundreds of thousands of pounds have been invested in electric lighting) that more capital is required to carry on with, well may our esteemed editors ask "What will they do with it?" I was about to ask "What have they done with it?" but your correspondent has told us that it has been spent in much tentative work and experimenting. And also, I presume, in giving a little practical instruction to some of those gentlemen who strut about the office with an eyeglass, or rattling a bunch of keys in one pocket and some easily-earned cash in the other, and whose highest electrical attainments appear to be to talk about volts and ampères, and some of whom are not particular in talking about ohms of current and volts of resistance.

I perfectly agree with your correspondent when he says, or rather infers, that the adoption and growth of electric lighting will be slow, especially at the rate of development of the present moment. Practical electricians know that with a very much smaller capital, a fair amount of business tact, and, above all, a determination to make a business undertaking pay; more, infinitely more, could have been done for the real advancement and development of electric lighting than has been done by those who have tempted the public to invest their capital into undertakings with which they had no practical acquaintance.

No doubt it is difficult to convey to an *outsider* the difficulties connected with electrical distribution, but your correspondent will find it much more difficult to give a proper and satisfactory answer to my letter of April 14th; whether he takes the cudgels up or whether he leaves them alone the *facts* will remain the same.

Your correspondent may also receive a little consolation by being informed that instead of my being an outsider I am an insider, and quite within the range of comprehending the problems that appear so difficult to him, and further, as long as our esteemed editors will admit, I hope to be allowed to speak my views in a plain and candid manner without fear or favour.

A. J. Jarman.

London, *April 23rd*, 1883.

Insulating Electric Light Leads.

Much interesting matter has been written to you within the last month or so on the resistance of electric light leads, safe currents, &c., but no new device has as yet been submitted for cheaper insulation of the same.

I would respectfully submit to your own and your readers notice the following, which my experience in mining engineering has led me to think about.

I wish to accomplish the following things :—

1st. To get a cheaper means of insulating large conductors;

2nd. To obtain facilities for increasing the capacity of the conductors as the system enlarges;

3rd. To reduce to a minimum the chance of insulation breaking down;

4th. To have free radiation for the heat which is evolved;

5th. To be able to carry off all moisture formed by such heat on the inside of the pipes, &c.

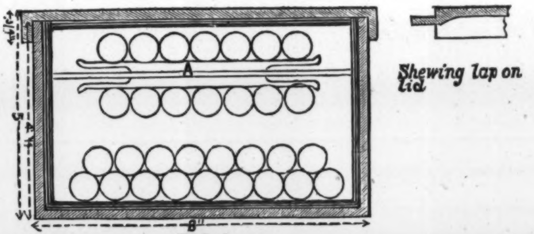

FIG. I.

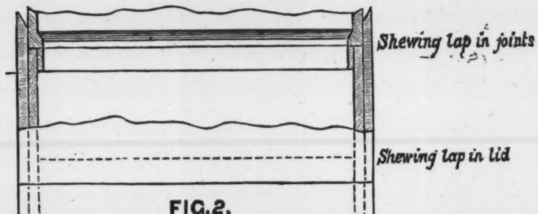

FIG. 2.

The above I propose to attain :—

(A.) By having iron (or other suitable) troughs of some such form as shown in sketch.

Fig. 1 showing section.

Fig. 2 showing plan, with trough joints and lid joints, which it is not proposed to fasten down, except by means of white lead or other suitable material, never having two joints coinciding.

Laying such boxes just inside the curb, and, if necessary, below the level of the pavement, it is possible to increase the size of the troughs by the depth to which they may at first be buried.

(B.) By insulating bare conductors upon highly-glazed porcelain insulators (marked A in sketch) mounted on iron bars running through their centres, for the + current, and by laying the — leads on the bottom of the iron trough entirely free from any insulation.

The above leads must be painted or varnished to prevent corrosion.

(C.) Sketch shows a box, of internal measurement 7½ in. × 4½ in., *full* of leads, which have been added to the one first put in.

There are 14 + and 15 — wires, each of ·589 sectional area, capable together of carrying a current, according to Mr. Moulton's limit, of 16,490 ampères.

To add to the leads it is only necessary to open the troughs and lay in the new conductor at the bottom if —, or attach to the old ones if +.

(D.) There is little or no chance of a break in the insulation, as far as I can see, if the arrangement is properly laid down to begin with.

(E.) As the wires have no heat-retaining substance on them, except the coat of paint, the heat will radiate into the trough.

(F.) To carry this off and prevent moisture accumulating a large current of air is constantly drawn through by ending the trough in a chimney, and, if necessary, having a small fan-blower to force the air through.

Trusting you may be able to find room for this idea in your already crowded and interesting journal.

Francis A. Pocock, M.E.

London, *April 17th*, 1883.

Long-Distance Telephoning.

I take leave to make some comments on the editorial article on "Long-distance Telephoning," which appeared in the Review of April 7th, inst.

You are pleased to say that "the success obtained in this case (telephoning a distance of 1,000 miles) can hardly be said to be a scientific triumph, it is rather a commercial one. Provided capital is forthcoming, telephonic communication can be extended to almost any distance without further invention being required," "and we have no hesitation in saying that the instrument used could have generally contributed but little, if any, to the success obtained." You also say "that wire of high conductivity is of great value for automatic telegraphy, in fact, like long-distance telephony, high-speed working, to a great extent, depends upon the use of wire of this kind." "We do not mean, however, to say that the solution of the problems is entirely dependent upon the conductor employed. It also depends upon the instruments, though considerable advances require yet to be made in the construction of the latter before further success can be obtained," and "given an unlimited command of capital the required results can be obtained at once." I make these extracts from your article the subject of my comments because there seems to me to be somewhat of contradiction between the several statements—at all events, they leave my mind in a confused state as to the opinions of the writer.

If it be a fact that "given an unlimited amount of capital the required results can be obtained at once," why then do you say that "considerable advances require yet to be made in the construction of the instruments before this success can be obtained"? You certainly cannot mean that capital is to supply the place of "an inventor's brains."

In one place you say, "provided capital be forthcoming telephonic communication can be extended to almost any distance without further invention being required." Now I put it to you how does that statement correspond with your statement "that considerable advances require to be made in the construction of the instruments before further success can be obtained"? Can these two statements be reconciled one with the other?

In the "long-distance telephoning" to which you refer you say, "we have no hesitation in saying that the instruments used could have generally contributed but little, if any, to the success obtained." Here you seem to ignore the "product of the inventor's brains" and attribute the success obtained when the Lockwood-Bartlett and Hopkins' apparatus were used to the great conductivity of the wire. I respectfully ask if the success is to be attributed to the wire used on these trials when conversation was carried on through a distance of 1,000 miles, what "considerable advances in the construction of the instruments" are required? for there is no doubt that conversation was carried on by the instruments named a distance of 1,000 miles. Can it be that you think telephoning over 1,000 miles is a small affair, as you write of telephoning to any distance without further invention being necessary?

You are pleased to say, "certain merits the Hopkins and also the Lockwood-Bartlett apparatus possess, but we certainly cannot credit them with being instrumental to any great extent in enabling long-distance telephony to become possible."

It seems to me that you have passed judgment upon these instruments *in contumaciam*, at all events upon the Lockwood-Bartlett apparatus used on the trials referred to.

I speak having full knowledge of what I state, and I say that you have never tested that apparatus; that you have never had it in your possession, or even seen one, and you could have given judgment only upon an examination of the specifications and drawings of their patents of 1880, wherein you found the principles upon which their instruments were made, and your judgment must have been formed upon your understanding of those principles, and not upon any actual trials of the instruments, especially of the improved constructed instruments used on those trials.

I append some data regarding the compound copper-steel wire lately set up between New York and Chicago, 1,000 miles, over which the long-distance telephoning was lately made. The core is of steel, weighing 200 lbs. to the mile, electro-plated, with 300 lbs. of copper to the mile, making a conductor B. W. G. No. 4, and the resistance is 1,500 ohms for the 1,000 miles. A compound copper-steel wire is, as you write, no novelty. In 1871 the Automatic Telegraph Company of New York put up a single wire of this description between New York and Washington City, 255 miles, and with three medium-size Bunsen cells I transmitted 200 words a minute from Washington to New York, the system used being an improved Bain chemical system. When I used an ordinary iron wire over the same route thirty similar cells were required. There were several serious objections to the use of such a wire:—1. The copper whilst it increased the weight diminished the strength of the conductor; 2. In cold weather the steel was liable to and did frequently break; 3. When the copper became strained and the iron exposed to the air chemical action gradually destroyed the iron core. The copper covering, however, of this wire was very thin, which is not the case with the wire recently set up between New York and Chicago.

W. C. Barney.

April 22nd, 1883.

[We hope to reply to Mr. Barney's letter at length in our next issue.—EDS. ELEC. REV.]

Observations on the Figures of the Consumption of Zinc given by M. Trouvé for his Bichromate Batteries.—By M. E. Reynier.—The communication presented to the Academy at its last meeting by M. Trouvé seems to offer a contradiction which it is necessary to point out. The table of experiments shows a consumption of 456 grms. zinc in five hours, for 12 elements, or 7·6 grm. hourly per element. In this experiment the intensity of the electric current was 12·6 ampères at the outset, falling gradually to 6·3 ampères, or an average of 9·45 ampères. But a current of this intensity requires theoretically the consumption of 11·34 grm. of zinc hourly per element. It is always possible that the actual result may fall short of theory, but here we have a considerable excess. It is therefore to be desired that M. Trouvé would carefully repeat his experiments, so as to obtain more probable figures. Perhaps he may be led to modify the conclusion which he has believed it possible to draw in his former memoir.—*Comptes Rendus*.

LEGAL.

Ayrton v. Paterson & Co.

In the Chancery Division of the High Court of Justice, on Thursday week, before Mr. Justice Pearson, Mr. Cookson and Mr. Godefroi moved to restrain the defendants, who are electrical engineers, carrying on business at Little Britain and Dalston, from selling, contrary to their agreement with the plaintiffs, Professors Ayrton and Perry, certain instruments, ammeters, voltmeters, and other contrivances invented by the plaintiffs for measuring electric currents, resistance, and the like, without having previously submitted the same to be tested by the plaintiffs. It was stated that the defendants had recently made a considerable number of these instruments, and had refused to allow the tests to be applied. The names of the plaintiffs were engraved on the dials, and they had been in the habit of indicating on the box containing the instruments the result of their tests, and appending their signatures thereto. They considered that their reputation would suffer by the omission of these safeguards. Mr. Glasse, Q.C., and Mr. Macrory, for the defendants, desired that the motion should stand over for a week, which his Lordship permitted, but only on the terms of an undertaking by them not to sell any instruments such as were included in the agreement with the plaintiffs during that period.

At the sitting of the Court on Thursday, Mr. Cookson intimated that the parties had arranged that the motion should stand over till the following Thursday, on the same undertaking as was made by the defendants that day week, and his Lordship agreed to this.

Whorlow v. Devon and Cornwall Electric Lighting and Power Company, Limited.

The petition for the winding-up of the Devon and Cornwall Electric Light and Power Company, Limited, which was presented on 1st November last by Mr. H. Whorlow, a shareholder, again came on for hearing, before Mr. Justice Chitty, in the Chancery Division of the High Court of Justice on Tuesday. In November nine actions were brought by shareholders for the rescission of their contracts to take shares in the company, on the ground that they had been induced to subscribe for the same by reason of statements in the company's prospectus falsely representing that the company had the exclusive right of using in the districts therein named Mr. Lane-Fox's electrical inventions. On the 21st of December last, Mr. Cadogan, one of the plaintiffs in the actions referred to, obtained an order on motion for the removal of his name as a shareholder from the company's register, and for the return of the money paid by him in respect of his shares; but the order was stayed pending the hearing of the present petition. The allegations upon which the petition was based were that the concessions granted to the company had been discovered to be not so wide as had been anticipated, that the mis-statements in the prospectus had caused proceedings to be taken by the shareholders, that the company had practically never carried on business and could not carry on business successfully, and that for these reasons and having regard to the fact that by reason of the claims of the shareholders for the return of their money the assets of the company (including any uncalled capital) were insufficient for its purposes, it was just and equitable that the company should be wound-up. Since the date of the presentation of the winding-up petition, and of the successful motion, the actions against the company by its shareholders had increased to 35 or 37, and the plaintiffs, including Mr. Cadogan, strenuously oppose the winding-up of the company on the ground that the statutory effect of the winding-up order would be to place them in the same position as the contributories who had brought no actions and who had not been deceived by or had acquiesced in the prospectus; while if the petition were dismissed Mr. Cadogan, who had made out his case, and any other of the plaintiffs who should succeed in making out their cases, would rank as creditors against the company for the value of their shares. The petition was unanimously supported by all the shareholders other than those who had brought actions against the company.

Mr. Justice Chitty said that the truth of the allegations in the petition had been made out by the petitioner. It had been proved that the existing assets of the company were wholly insufficient for the purposes of its business, and, in fact, when fully realised, would amount to about one-fourth of the sum anticipated by the prospectus as the sum necessary for working the company. It was, moreover, the wish of the large bulk of the shareholders that the company should be wound-up. To say that the company must go on in order that the suing shareholders should escape the statutory effects of a winding-up was a wholly untenable proposition. Nothing could be more unfair than that the assets of the company should be exhausted in paying off in order of succession the claims of those shareholders who had succeeded by actions in having their names removed from the register of shareholders. Although the misrepresentations in the prospectus amounted in law to a fraud by the company, yet in fact the company was not their author, the true author being the hand who drew the prospectus. It was therefore legitimate for the company to say that so far as the company consisted of individual shareholders it was innocent, and that the proper way of meeting the case of all parties was to obtain a winding-up order. His Lordship was satisfied that the petition had not been collusively presented. He therefore made an order for the compulsory winding-up of the company, with usual costs.

Removal.—The Vulcanised Fibre Company (Mosses & Mitchell) have removed to their new premises, 68, 69, 70 & 71, Chiswell Street, Finsbury, E.C.

THE ELECTRIC LIGHTING COMPANIES AND THE BOARD OF TRADE.

A deputation representing the electric lighting companies had an interview with Mr. Chamberlain at the Board of Trade on Saturday last. The deputation was accompanied by Mr. Moulton, and consisted of Mr. Bouverie, Mr. Arnold White and Mr. Waterhouse, representing the Edison Company, and Mr. Crompton, Mr. Swan and Mr. Morris, jun., were also present. Mr. E. P. Bouverie, in stating the case for the deputation, said, some of the rules issued by the department seemed to throw obstacles in the way of the successful working of the act by the electric companies. It was proposed in these rules that an amount equal to three-fourths of the whole of the amount included in schedule A should be provided by the company for the purposes of the work; and that one half of the cost of executing the works specified in schedule A should be actually deposited for the purposes of security. He was well acquainted with the history of legislation for railway, gas, and other works, and he knew of no similar provision, and, in fact, it was contrary to policy, for if insisted upon people would not entrust their money in such undertakings. It seemed to him that the result would be the abandonment of the undertakings.

Mr. Chamberlain regretted the tone of Mr. Bouverie's remarks. Much had been done by the department to smooth away obstacles to the operations of the companies by putting them in agreement with the local authorities, and saving expense in applications to Parliament. In doing this they had been to a large extent successful. Negotiations had been going on in the most friendly spirit for two months. The department had been most anxious to remove any difficulties in the way, to abandon any unreasonable claims, and to remove any obstacle of which the companies complained. But while the Board must do everything to facilitate this experiment, they were also entrusted by Parliament to protect the interests of the public, and it was not in the interest of the public or of the *bonâ fide* companies that bogus companies should be established for the purpose of obtaining a *quasi*-monopoly, which there was at one time great fear would be the case; for there had been applications which, if granted, would have placed the control of the further development of the system in the hands of the people who had no knowledge, no ability, and no means, and who were simply speculators with other people's money. The Board, therefore, wished to devise some means by which they might separate the bogus from the *bonâ fide* companies, and they had not at present seen their way to any other means of doing this but by insisting upon some deposit of money. He would be glad if he could see his way to meet any objection which might be raised, but he would say that those conditions which seemed unreasonable to Mr. Bouverie had been accepted willingly by other companies. What were these terms which were considered unreasonable by Mr. Bouverie? The Board had made a rule that one half of the amount which was required to make the street works in the first schedule should be deposited, whatever proportion to the capital that might bear; but he doubted whether it would amount to more than one-sixth of the total sum which would be invested in any of these undertakings. Mr. Bouverie has said that there were no arrangements for the repayment of these sums, but in that he was mistaken, as it was distinctly provided for in the Act, and if that were not clearly expressed, it might be made so after conference between the parties. He said so much as to the actual proposal, but if they could get the consent of the local authority in any case to the reduction of the amount proper, the Board of Trade would not think it at all necessary to stand out in opposition to such an agreement. But he had considerable doubt whether the terms offered of eight per cent. by the Vestry of St. George's, Hanover-square, would be more advantageous to the company than the terms proposed by the Board; for in the former case the money was locked up until the completion of the work, whereas by the latter arrangement the money could be drawn in sums of not less than £1,000 during the progress of the operations. A question had arisen with regard to insolvency, and it had been pointed out that the clause was almost taken *verbatim et literatim* from the Tramways Act, which had been to a considerable extent the basis upon which legislation had gone in this matter. There was also the question of transfer, which had been touched upon. Mr. Bouverie complained that the Act stipulated that no transfer of an undertaking should take place without the consent of the Board of Trade, but there had been a clear indication of the mind of Parliament that the department were to look into every case in which transfer was proposed, and consider if there were any good and sufficient reasons for objecting to it, in which case only would the Board interfere. If no good and sufficient reasons were urged against the transfer the Board would not consider it their duty to withhold their consent. As to the appointment of inspectors, there again the Board were under statutory obligations, and they had no power or no funds to make appointments; but, even if they had, he did not like the notion of centralisation, of which they had already too much. A question had been raised as to the penalty of revocation which was imposed for a breach of the order. It had been urged that this was an extreme penalty, but he knew of no other expedient which would as readily ensure the compliance with the terms of the order; and it was well that the Board should be able to hold such a power over the head of the company *in terrorem* in order to secure the adequate fulfilment of the contract under which they came. In conclusion, they might say that the order in its present form had been accepted and acted upon by several companies already established. With regard to any particular case which might hereafter be brought before him, he would be glad to consider circumstances which would justify the alteration of the general scheme; for, of course, he did not say that the order which was made was to meet all the varied circumstances which might from time to time arise.

NOTES.

Electric Lighting.—Messrs. Ganz & Co.'s (Budapest) installation of 20 arc lamps of 600 C. P. each in the salt mines of Szlatina (Hungary) has given general satisfaction, and the firm has now been intrusted with the extension of the lighting plant of the salt mines at Maros-Ujvár, where there are at present 14 arc lamps, and to these will now be added 14 arc lamps of 600 C. P. each. The new lighting plant will be fed by a separate alternating current dynamo-electric machine, but both the old and new machines will be driven by a common steam-engine. This firm has just signed a contract for the electric lighting of the Telegraph Offices at Budapest, which will be furnished with 200 Swan lamps, for 10 years. The whole must be finished in three months. Other newly-ordered installations of the same firm are the spirit distillery of Messrs. Grunwald & Co., at Budapest; the Lurhalle of Mr. Rosner, at Budapest (200 Swan lamps); the steel works of Messrs. Bohler Brothers, at Waidhofen (Austria); and a large dwelling-house (Arcaden) at Vienna, with 250 Swan lamps, where the inhabitants will be supplied with electric light, the price of which is paid in the dwelling rent.

The Telegraph Construction and Maintenance Company is, according to the *Pall Mall Gazette*, issuing circulars to the various municipalities stating that their prices are such as will enable electricity to be supplied to the consumers at a cost considerably lower than that of gas. It would be more likely to command credence if the company was able to point to a single town in which electricity is supplied as cheaply as gas. At present, we believe, no such town is in existence.

"On 'Change there has been a considerable decline in the shares of a number of the principal electric light companies. The reason of the fall is alleged to be the threatened competition of the Telegraph Construction and Maintenance Company, which is 'going-in' for electric lighting, and has acquired the control of a new dynamo-electric machine which insures very much cheaper production than has been hitherto found practicable." So says the *Bullionist*. If the above be true, and we see no reason to doubt its accuracy, it shows how very little is required to still further depress those already depressed shares.

An interesting and instructive lecture on "The Electric Light in Our Homes" was delivered on Friday week, at Leeds, by Mr. R. Hammond, of London. Avoiding technicalities and using language which, if not always strictly scientific, was nevertheless the best for a popular treatment of the subject, the lecturer explained at length the various stages of electric lighting, and the principal experiments which led up to the invention of the incandescent lamp. Touching upon the various forms of artificial lighting and their several defects, and the dangers arising from the consumption of coal-gas, he said his idea of a perfect light was one that did not rob the air of its life-sustaining element, oxygen, and that was under easy and absolute control, and that was capable of such sub-division as to be adapted to ordinary everyday use. These qualities he claimed for the incandescent lamps with which the drawing-room fitted up on the stage of the hall was effectually lighted. Experiments demonstrative of the complete control of the lights, and the absence of all danger from fire, were successfully made. Speaking of the cost Mr. Hammond declared that this year he had spent much care in manufacturing and distributing electricity throughout his house, and he found the cost to be £5 less than he must have spent to produce the same illuminating results by gas. His calculation was of course based on the price of gas in London.

In the Edison Exhibit at the Royal Aquarium about 230 16-candle lamps have been substituted for the 8-candle type at first employed. Since the 23rd inst., the current at the Edison Central Station, Holborn Viaduct, has been on the mains throughout the twenty-four hours, and will continue to be so in future.

The new Guion Liner, s.s. *Oregon*, at present building by Messrs. John Elder & Co., Glasgow, is to be lit throughout by the Edison Electric Light Co. The generating plant will consist of two duplicate 500-light dynamos and engines.

We read the following in *La Lumière Electrique*:—The German Steam Navigation Company "Kosmos," of Hamburg, has been making an experiment on board of one of its mail steamers, whilst on a voyage in the Pacific, with a projector manufactured by Messrs. L. Sautter, Lemonnier and Co., of Paris. The apparatus was placed in the bows of the ship, so that the luminous rays should not meet with any obstacle. The power of the electric light was equal to about 400 becs-Carcel. On the return of the vessel, Captain Wilson declared himself highly satisfied with the projector, which had proved to be a great help, and he further stated that he would not hesitate to navigate during night time, by means of the projector, in quarters looked upon as dangerous. In consequence of this report, the company has decided to provide, successively, the whole of its fleet with those apparatus, following therein the example of the Austrian Lloyd. It is probable that the disasters recently experienced by the German Navigation Companies have something to do with the initiative which they take in this manner. It is to be hoped that our companies, always ready to assure the comfort of travellers, will not allow themselves to be forestalled in the use of apparatus which increase the safety, and the price of which is so very small compared with the enormous value of their mail steamers.

The Royal Mail steamer *Roslin Castle*, which was launched from the shipbuilding-yard of Messrs. Barclay, Curle & Co., Whiteinch, for the Castle Mail Packet Company's South African service, is to be fitted throughout with incandescent lamps.

Electric lighting will, it is stated, be discontinued at Norwich at the end of the present month.

To give greater security upon the Calvados coast and at the mouth of the Seine, it is proposed to erect at Point-du-Castel, near Saint Auben-sur-Mer, a new electric lighthouse.

The Committee of the Reform Club contemplate a trial of incandescent lamps, fed by an Elphinstone-Vincent machine.

The Town Council of Colchester has made an agreement with the South Eastern Brush Company for the electric lighting of a section of the town.

A New Current Measurer.—Mr. Sabine has lately completed a new current dynamometer of very simple construction, and which may, therefore, be expected to be produced at a lower price than those hitherto in use. This instrument, which we have seen, contains some novel points. The employment of torsion, which supplies the directing force of the suspended coil in all other dynamometers, is dispensed with and the use of gravitation substituted. The suspended coil is supported upon two chains or links of wire, in such a way that when the coil is deflected it is lifted up through a height corresponding to the angular position assumed by the suspending links, and when the deflecting force is removed the coil falls back by gravitation to the lowest point which coincides with its zero point. By this contrivance, Mr. Sabine claims to avoid entirely the loss of zero which is complained of more or less in all dynamometers on the torsion principle, and notably in those in which a spring is employed. Another peculiarity in the instrument is that the suspended coil forms, with one of a set of resistances, a shunt to the main coil, the set of resistances being introduced by a switch, and altering the sensitiveness of the instrument, so that any current between 1 and 100 ampères, or more if necessary, can be read off on the same scale. The thicknesses of the wires of the suspended coil and of the several resistances are adjusted so that in a given short interval the heat generated by the current in the main coil and in the shunt shall still leave the suspended coil and its resistance in the same relation to the main coil. The contacts with the suspended coil are made by means of a double mercury cup, which can be readily removed and filled or emptied. The instrument is, of course, equally available for continuous and alternating currents.

Fire Risks from Electric Lighting.—We have received a modified copy of the rules and regulations recommended by the Society of Telegraph Engineers and of Electricians for the prevention of fire risks from electric lighting. We referred to this subject some time since, and we do not see any reason now to modify the opinion we have already expressed, that these rules and regulations are quite unworthy of the society responsible for their production.

Transmission of Power.—Vienna owns several small establishments for the supply of steam-power to small mechanics. It is now contemplated to found a large central establishment from which electrical power will be transmitted to the smaller industrial ones.

Telephonic Overhead Wires.—At a meeting of the St. Olave's Board of Works, last week, a letter was submitted from the Marylebone Vestry, asking for a representative to a deputation about to wait on the Home Secretary, in respect of the danger to the public from the constantly increasing number of telephonic overhead wires. Mr. Beresford said telephone companies' wires were increasing at an alarming rate. Some companies were actually erecting "dummy" wires to make it appear they were doing business. A representative to the deputation was unanimously appointed.

The Telephone and Signal Stations.—Telephonic communication has been established on the coast of Ireland, between Old Kinsale Head, the signal station of Kinsale, and Queenstown. The distance is about 34 miles. Last year telephonic communication had already been made between Queenstown and the signal station at Wearer Point, on the west side of Cork Harbour, opposite Roche Point. This line has for some time been used for the transmission of signals to the Atlantic steamers. The good results obtained have since induced the Government to extend this work. Up till then, the only telegraph station to the westward was that of Crookhaven, from where the news, brought over by homeward bound steamers, is forwarded. Old Kinsale Head, a point which projects well in the sea, has always been considered as one of the most favourable points to establish a signal station. At the present there are on the Irish coast six stations which are in communication with the Atlantic cable, viz.: Queenstown, Spy Hill, Carrigalor, Wearer Point, Kinsale Towers, and Old Kinsale Head. The telephonic communication works very satisfactorily and Gower's telephone is used for these purposes.—*La Lumière Electrique.*

The Vienna International Electric Exhibition.—According to official information received by the commission of the exhibition, the Imperial German Government, at the invitation of the Austro-Hungarian Minister of Foreign Affairs, has consented to exhibit.

The Crystal Palace Electrical Exhibition, 1882.—The Duke of Teck on Wednesday evening presented the successful competitors in the above exhibition with the diplomas and medals awarded by the jurors. The awards were given in the Concert Hall of the Crystal Palace, and there was a large assemblage of visitors. His Serene Highness was received by Major Dickson, M.P. (Vice-Chairman), and the General Manager and officials of the Crystal Palace Company, and a guard of honour was formed by the Palace Company of the Croydon Volunteers. Among those present were Dr. Read, Mr. Spencer, Mr. Thomson (directors), Mr. W. Gardiner (secretary), Mr. G. S. Cleather (manager), and Mr. Kimber (solicitor), of the Crystal Palace Company, and Mr. Grantham, M.P. The list of those competitors who received medals has already been published. Diplomas for the general excellence of their exhibits were given to the following, who did not compete from trade motives:—Her Majesty's Postmaster General, the Secretary for War, the Anglo-American Telegraph Company, the Eastern Telegraph Company, the Telegraph Construction and Maintenance Company, the Submarine Telegraph Company, the South-Eastern Railway, the London, Brighton, and South Coast Railway, C. F. Varley, for his induction machine and condensers; R. H. Froude, for his dynamometer. Later in the evening the Duke of Teck was entertained at dinner by the directors of the Crystal Palace Company, and amongst the guests were Prof. Hughes, Mr. Holms, M.P., Sir Arthur Otway, M.P., Sir Francis Truscott, Col. Haywood, Dr. Frankland, Mr. J. Glaisher, F.R.S., Prof. Carey Foster, Prof. Adams, Dr. Russell, F.R.S., Mr. R. Harris, Mr. Spagnoletti, Mr. S. Leoni, and Mr. George Livesey.

The Manchester Electrical and Engineering Exhibition.—The Exhibition of electric and gas lighting apparatus and general engineering machinery, which was opened a short time ago at St. James's Hall, Manchester, is now in a complete state, and contains much that is interesting to the general public, as well as to the practical electrician and engineer. Although a large number of the exhibitors are from Manchester and the vicinity, there are others from London, Birmingham, Sheffield, Cardiff, Derby, Leeds, Liverpool, Lincoln, Nottingham, and other towns, so that the Exhibition is of more than local interest. A general glance at the electrical portion of it indicates at once the rapid progress which is being made in the science of electricity and the increasing variety of uses to which it is being put. The Exhibition is lighted by three large Lever arc lights suspended along the centre of the hall, and a similar number of Lever lamps are placed on the exterior of the building. These lamps are worked in series, and are each of 2,000 nominal candle-power. They are driven from a Chadwick's stationary engine, and the current is generated by a special Gramme dynamo, excited by a smaller machine. The maximum current is 15 ampères, the E.M.F. being about 30 volts per lamp. This installation has been made by Mr. Richardson, the maker of the lamps. As the majority of the stands are also illuminated by electric lights of various kinds, the effect at night is exceedingly brilliant. One end of the hall is occupied by the Electrical Power Storage Company, which exhibits its well-known accumulators, which are employed in a variety of ways, including the driving of a band saw, a lathe, and a sewing machine. The Edison electric light is shown in various forms, as is also the Swan system of electric lighting. In the engineering department of the Exhibition are to be found gas and steam-engines of all kinds, many of them being shown with especial reference to their suitability for use in connection with lighting by electricity. Amongst new inventions may be mentioned Robinson's hot-air engine, which has been designed more especially for driving printing machines, dynamo-electric machines, &c. The engine, which is vertical, and occupies but a small space, obtains its power by the alternate and regular heating and cooling of air. It is claimed for the engine that its motion is extremely steady, and that it will run continuously when once the gas-burner is lighted, without attention beyond occasional oiling. The "Lumley" dynamo machine is exhibited by Messrs. Pike, Sanderson & Pike, of Manchester, together with electric signals, incandescent lamps and fittings, lightning conductors, and automatic apparatus for sounding alarm in case of fire or stopping engines in manufactories in case of accidents. The "Otto" gas-engine is shown by Messrs. Crossley Brothers, of Manchester, and Matthews's compound high-speed triplex engine, specially designed for driving dynamos, &c., direct, and the same patentee's paragon dynamo for arc-incandescent lighting and depositing purposes, by Mr. B. Goodfellow, of Hyde. Colliery signals, speaking tubes, fire and burglar alarms, gas lighting by electricity, electric communications between railway passengers and guards and engine-drivers, together with other telegraphic and electric appliances, are illustrated by Mr. J. Faulkner, of Strangeways. Messrs. Faraday & Son make a display of new designs in electroliers, &c. Reflecting lanterns, made for the workings of the Severn and Channel Tunnels, auditorium fittings for theatres, saloon fittings for ships, and an ingenious double-swivel bracket for bedrooms, also form part of their exhibit.

Obituary.—We have to record the death of Mr. William Cherry, the foreman of the mechanical, the fitting, and the erecting departments of the well-known firm of Messrs. Johnson & Phillips, telegraph engineers, Charlton, S.E. The burial took place at the quiet little Brockley cemetery, and besides the chief mourners, there were gathered together at the grave the heads of the firm, all the officials, and many of the leading hands. It was the boast of this worthy man that he had always been at his duties by the hour of six o'clock in the morning during the whole time he had held the position of foreman in the works, and it might literally be said that he actually died in harness, for until the day before his death he was at his work as usual. It was under his supervision that some of the first, now celebrated, lamps, invented and patented by Mr. Brockie, were made, and at the time of his death we are informed that the heavy cable machinery destined for the new Postal Telegraph ship was being carried out under his care at the works in Charlton. In early life Mr. Cherry had been foreman in Messrs. Maudslay's works, and it was with some degree of pride that he would show a handsome gold watch, with which, as a mark of respect, the employés there had presented him.

Copper Wire Data.—In the table which was kindly placed at our disposal by Messrs. W. T. Glover & Company, of Manchester, and published in our issue of the 14th instant, a clerical mistake occurs; the decimal point, in area column square millimetres, should be placed in each case one figure further to the right.

Patents for Inventions Bills, 1883.—A meeting of inventors, patentees, manufacturers, and others interested in patent law reform was held in Glasgow on Tuesday, for the purpose of considering the Bills now before Parliament, and approving or amending the memorials drafted by the committee. Sir William Thomson presided, and said it would be seen that the Government Bill went but a very small way in the direction which for many years the committee appointed in connection with this subject thought desirable, and they should now, therefore, do what they could to have it amended into a satisfactory shape rather than rejected altogether. They all accepted with satisfaction the reduction of the fees during the first four years to £25, and looked forward to the reduction in the same proportion of the fees paid in the later stages. To take £50 in the fourth year, and £100 in the eighth year, from inventors was simply to impose a plunder tax—a most iniquitous way of clearing the ground of patent encumbrances. He believed a perfectly effective way of getting rid of useless patents would be to impose a small annual fee of £1 or £2 during the whole duration of a patent. The very necessity of having to pay such a sum annually would lead a person to consider whether it was worth while continuing to do so if there was not something in the patent which he was ready to defend. Another point on which there was much feeling was as to the duration of patents, and all he would say in regard to it was that he approved of the proposal of twenty-one years in Mr. Anderson's Bill—a proposal which was also adopted in the Bill of the late Government. Resolutions were carried approving of the Patents for Inventions Bill brought before Parliament by Mr. George Anderson, agreeing to petition Parliament for the amendment of the Patent Bill of the Government, and to memorialise the Board of Trade.

Submarine Cable Maps.—The Canadian Government is about issuing a series of maps showing the submarine cables of the world. They have been prepared under the supervision of one of the fathers of submarine cables, Mr. Frederic Newton Gisborne. They are in five sheets, three by four feet each, each map complete in itself.

Telephonic Communication between New York and Chicago.—Telephonic connection between New York and Chicago was made again on the 15th instant (says the *Chicago Times*) with appliances different from any that have heretofore been tried, the wire of the Postal Telegraph Company being used. [This is the wire of high conductivity already noticed by us.] A number of gentlemen from New York came here a day or two since, bringing with them instruments known as the "molecular telephone." In these instruments there is a large piece of cork placed in a box somewhat similar to a Bell telephone box, but very much smaller. In this instrument the sound is absorbed by the piece of cork, and through molecular action is conveyed to a microphone that is imbedded in it. The receiver differs from an ordinary receiver in using as a diaphragm anything that is not susceptible to magnetism, such as cardboard, wood, or rubber. The magnet has one end elongated and recurved upon itself, and both ends being in the same pole, it repels instead of attracts. As the vibration is due entirely to the magnet itself and not induced by an armature, all disturbance is obviated from induction. [This we need hardly say is a fallacy.] In the test made yesterday of those instruments one transmitter was used. Dr. H. E. Waite, of New York, spoke over a circuit on which there were six receivers, so that the communications were heard at this end by six persons at one time. The weather being very heavy was unfavourable for a fair test, but after a little difficulty in having a "ground wire" at Cleveland removed, the well-known "Hello!" was soon heard coming from New York, and was sent in return, and conversation between the two points, over a thousand miles of wire, began. Mr. S. H. Robbins, of New York, transacted some important business with Col. Abner Taylor, of Chicago; and the voices of Prof. Gray, S. H. Bartlett, Mr. Waterbury, and others in New York, were distinctly heard at the Chicago end of the line. A large number of prominent gentlemen were present, among whom were A. B. Pullman, J. B. Drake, Warren Leland, L. D. Parker, of the Postal Telegraph Company; Col. Abner Taylor, J. E. Fuller, Manager of the Underground System of Telegraphy; Prof. Barrett, Mr. Sprigg, of the Mutual Union; Col. Peters, of the Danville and St. Louis Railroad; Col. Duncan B. Cannon, Western Manager of the Molecular Telephone Company; M. Hicks, of the Pullman Car Company; F. W. Mowbray, of the United States Rolling Stock Company; and others—all of whom expressed themselves as highly pleased with the results obtained, especially when the unfavourable condition of the weather was considered. Warren Leland recognised the voice of his brother Horace through the telephone, not knowing he was there. Among those persons who were present at New York at the exhibition were John Jay Knox, Controller of the Currency; George J. Coe, President of the American Exchange National Bank; A. W. Beard, President of the Postal Telegraph Company; W. T. Wardell, H. R. Boltzer, of Boltzer & Lichtenstein; A. D. Swan, ex-Judge Dent, of Washington; John I. Waterbury, and C. F. Livermore. Conversation was held with Dr. Henry E. Waite, I. D. Parker, Superintendent of the Postal Company, and Warren Leland, sen., in Chicago. [We are informed that the instruments used in these trials were the carbon-cork transmitter of Lockwood and Bartlett, patent 2418, A.D. 1880, constructed with three carbon pencils, loosely connecting two carbon blocks, the whole imbedded in cork, as similar to those described in the REVIEW of 14th April; and the receiver is also Lockwood and Bartlett's patent 2419, A.D. 1880, and a description and drawing of which appeared in the REVIEW on September 15th, 1881.]

On the Theory of Electro-magnetic Machines.—By M. Joubert.—The experiments made by M. Tresca on the machines of M. Deprez, give for the first time in a precise form the measure of the phenomenon already known but not explained, that there is a loss of work in the machine in addition to that which is the consequence of Joule's law.

This loss has been ascribed to different causes, but as far as I am aware, the following, which is in my opinion by far the most important, has not been pointed out.

All the so-called "continuous current" machines are formed by a certain number of elements, such as the coils of Gramme's ring, which, *e.g.* in the case of a machine acting as recipient, pass from a position where the potential energy has a maximum value, W_0, to another diametrically opposite, of the minimum value W_1. The difference, $W_0 - W_1$, represents the electro-magnetic work performed by the coil in passing from the first position to the second. In order that the work may continue, it is necessary at this moment to reverse the direction of the current in the coil, that is to say, to destroy in pure loss the electric energy which it possesses and restore to it entirely the primitive energy, W_0. The operation is repeated for each coil twice per revolution.

Making abstraction of the work of the resistance, the yield is therefore

$$\frac{W_0 - W_1}{W_0}$$

It is easy to determine the lower limit of the electric energy which is thus sacrificed at each half revolution, which is manifested, in part, at least, in the form of a spark. If we call I_1 the intensity of the current at the moment when it is destroyed in the coil, and l its coefficient of self-induction, the value of this loss is

$$\frac{l I_1}{2}.$$

If the ring is composed of p coils, and if it makes n revolutions per second, the loss in each unit of time is, therefore, at the minimum of $n\,p\,l\,I_1^2$, or $n\,L\,I_1^2$, when L stands for the co-efficient of self-induction of the entire ring.

It is known experimentally that in the recipient machine the change of the direction of the current must take place before the coil passes by the line of the poles. The position of the commutator, or the brushes, is given analytically by the condition that the electro-magnetic work $W_0 - W_1$ is the maximum.

All the co-efficients which intervene in the equations may be determined directly. The verification of the theory is therefore relatively easy. I have been happy to find an indirect confirmation in the figures published by M. Tresca; the value thence deduced for the co-efficient of self-induction of the machines of M. Deprez is quite within the limits of magnitude which correspond to this kind of machines.—*Comptes Rendus.*

NEW COMPANIES REGISTERED.

London and Derby Electric Wire Company (Limited).—Capital £5,000, in £1 shares. Registered office, 122, Fore Street, E.C. Objects: To acquire for £260, in fully paid-up shares, the business of Bindoff Levi and Co., electric and telegraph wire manufacturers, of Royal Victor Place, Old Ford Road, E. Signatories: *J. Hunt, 122, Fore Street, 150 shares; *L. Musk, 73, Mortimer Road, Kingsland, 10 shares; *C. W. Boot, Camborne, Cornwall, 150 shares; *W. Higginbottom, Derby, 150 shares; *E. Bindoff, 20, Southborough Road, South Hackney, 10 shares; *W. J. Levi, 25, Forest Road, Dalston, 10 shares; G. J. Thornhill, 76, Wood Street. Directing qualification, shares or stock to the nominal value of £100. Registered 18th inst., by Orlando G. Harman, 20, King's Arms Yard, Coleman Street.

Patent Self-Binding Telegraph Insulator Company (Limited).—Capital £5,000, in £1 shares. Objects: To purchase the letters patent of Joseph Slater Lewis, of Birkenhead, for improvements in or relating to insulating apparatus for overhead telegraph lines and other wires for carrying electric currents. Signatories (with 1 share each): *J. S. Lewis, Birkenhead; J. Thornely, Helsby; J. Moss, Helsby; J. Brandreth, Helsby; J. G. Thomson, Neston; W. V. Thompson, Liverpool; D. J. McKenzie, Liverpool. Mr. J. S. Lewis is appointed managing director Registered 19th inst., by Chester & Co., Staple Inn.

Compound Rubber Company (Limited).—Capital £7,000, in £1 shares, with power to increase. Objects: To acquire the inventions of Alexander Parkes, of Bexley, in connection with improvements in the manufacture of compounds for insulating electrical conductors, and for other uses, for which he has obtained provisional protection. The consideration is £1,500 in cash, and 5,250 fully-paid shares. Signatories (with 250 shares each): T. Klein, Stoke-on-Trent; G. J. Cuddon, 4, Broad Street Buildings· W. Hull, Hibernia Chambers, London Bridge; G. W. Kekewich, Junior Carlton Club; J. Blow, Junr., 16, Victoria Road, Clapham; J. H. Redfield, 48, Lime Street, R. R. Edwards, 6, Lansdowne Road, Dalston. The signatories are to appoint the first directors. Qualification, 250 shares. Registered 23rd inst., by H. C. Parkes, 8, Old Jury Chambers.

Mexican Gas and Electric Light Co. (Limited).—Capital £100,000, in £20 shares. Registered office, 15, Bishopsgate Street Within. Objects: To acquire contracts and other powers from the Government, municipal, or other authority in Mexico for the purpose of gas or electric lighting, and also to acquire the existing gas works in the capital of Mexico. Signatories (with one share each): *H. H. Gibbs, *A. Sillem, G. H. Gibbs, *J. C. Hayne, H. C. Gibbs, and *V. Gibbs, all of 15, Bishopsgate Street Within, and *W. Barron, of 12, Rue de Berri, Paris. Registered 24th inst., by Randall & Angier, of 3, Gray's Inn Place.

Signatories whose names are preceded by an asterisk are also directors.

CITY NOTES, REPORTS, MEETINGS, &c.

The Brazilian Submarine Telegraph Company (Limited).

The report of the directors, to be submitted to the nineteenth half-yearly general meeting on Friday next, states that the revenue for the half-year ending 31st December last amounted to £88,408 18s. 0d.; and the working expenses (including £2,146 9s. 9d. for repairs of cable) to £14,971 5s. 2d. After providing £1,311 17s. 0d. for income-tax there remains a balance of £72,125 15s. 10d.; to this is added £1,295 4s. 4d., brought forward from 30th June last, making a total of £73,421 0s. 2d. First and second interim dividends amounting to £39,000 have been paid, and £25,000 transferred to the reserve fund, leaving the sum of £9,421 0s. 2d. to be carried to the next account. The serious fault in the Lisbon-Madeira section, referred to in the last report, was removed on the 31st October, 1882; it had evidently been caused by the breaking of the wires by a ship's anchor; the fresh cable spliced in is now in closer proximity to shallow water, therefore less liable to be injured by vessels anchoring. The new cable between Lisbon and Madeira was successfully completed on the 19th October, 1882, by the Telegraph Construction and Maintenance Company, thus duplicating the first section of this company's system. All the company's cables are in good working order. The directors have appointed Mr. Carlos Frederico Taylor their representative in Brazil.

The Maxim-Weston Electric Company (Limited).

The second annual ordinary general meeting of this company was held at the Cannon Street Hotel, on Thursday of last week, the chairman of the company, Sir Edward Augustus Inglefield, C.B., F.R.S., presiding.

The Secretary (Mr. T. R. Comyn) having read the notice convening the meeting, the report, which we published in our last issue, was taken as read.

The Chairman moved the adoption of the report. He regretted that the nominal capital of the company had not been larger. Of the 44 companies that had been promoted, 34 had larger capitals than the Maxim-Weston. All things considered, however, he did not think they had done so very badly. Though they had lost £70,000 in the purchase of patents which they had not used, and had conducted the lighting of the City at a loss, they had managed to avoid getting into difficulties. The contracts they had had were all more or lest competitive, and though they were successful as regarded lighting, contracts were not always profitable. In the Metropolitan Railway, the contract for which had been undertaken before that company was formed, they lost £1,225. He did not think the directors could be blamed for that. (Hear, hear.) Then there was the lighting of part of the Edinburgh Post-office. In it they were pitted against two other companies, and thought themselves lucky to get the installation, with the promise, if successful, that they should have to light, perhaps, the whole of the office. At that installation they put up an engine powerful enough to do three times the amount of work that was then required of it. The engine and the dynamo and the people who had to work them were just as expensive for three lights as for 300. Therefore where they put in a smaller number of lamps, with the anticipation of putting in many more in a short time, and did not have the opportunity of doing so, they were at a loss, and in the Edinburgh Post-office they lost £382. At the very moment their contract expired they withdrew. At the Botanical Gardens they thought they had a good contract, after exhibiting there, but lost £26. At Reading they also lost £26. In the City contract, upon which they subscribed their money, and in the City the reputation of their lights had been established, they were at a loss of £4,405. ("Oh!") It sounded badly, but how did it come about? (Hear, hear.) They started with a new company, and the Brush and other companies, they might depend upon it, did not give information to a rival company. Their cables had to be laid two or three times. The contractors who made them did not prove equal to the task they were required to perform, and their great losses in the City lighting had been owing to these cables. However, in that contract they had gained a certain amount of experience. They were pressed now to engage in another contract for City lighting, but if they did so, this time it would be at a profit. (Hear, hear.) They had expended no less than £1,347 over the Crystal Palace Exhibition; Warwick House, £181; Guildhall, £162; Albert Hall, £50.

A Shareholder: Are these losses?

The Chairman said the exhibitions were entire losses. They got credit, but had to expend money to get that credit. At the Opera House they lost £128. In all, £1,868 had been expended on exhibitions. Having got all they could out of the exhibitions, they declined to exhibit any more. (Hear, hear.) They agreed with other companies that they should not exhibit any more unless they were paid for it. (Hear, hear.) They had said so at the Alhambra, at the Aquarium, and at other places. He only mentioned these facts because he thought they were reasons—having paid for their experience excessively dearly, having plenty of contracts and plenty more in view, and knowing exactly what they could do—for justifying him in asking them to carry on the company. He, of course, anticipated some questions (hear, hear), perhaps disagreeable ones, but he hoped he could give agreeable answers. (Hear, hear.) He should no longer continue his preparatory address because all questions that might be put would be answered. His duty was to move the adoption of the report and accounts of the directors. They might as well, he thought, postpone reference to the position of the company till the extraordinary meeting to be held immediately afterwards, when the matter could be gone fully into, and now pass the formal resolutions.

A Shareholder: The first meeting is for the ordinary business of the company?

The Chairman: Yes.

The Shareholder: Then you must go on with that now.

Sir H. B. Sandford seconded the adoption of the report and accounts. They saw from the accounts that £14,456 was the amount of the debtors. £10,000 of that was due by the Lancashire company when they had allotted more of their shares. It was not all due at once. In the balance-sheet they would see that the expenditure for the year amounted to £16,302, which was against £16,480 in the previous year, being only a difference of about £180. In last year's expenses there were £3,109 for depreciation of stock, an item which did not appear in the first year's expenses, and in the legal expenses there was an excess of £658, which the directors could not possibly help, and which ought to be credited strictly to the decrease in the expenditure of this year as compared with that of the previous year.

Mr. Lewis A. Tallerman thought that would be a favourable opportunity for him to make the few remarks he desired to (hear, hear). The accounts, which purported to be a balance-sheet, appeared to him to be more like a list of expenditures (hear, hear). For the concession to the Lancashire company the directors said £10,000 worth of fully paid-up shares had been received from that company, and that when the unallotted shares were disposed of a further sum of £10,000 in cash became payable. There had been two agreements, he believed, to that arrangement, the first being that £10,000 in cash should be paid, and the second by mutual arrangement that the payment of the money should be deferred. Was not that so?

The Chairman: Certainly, because the money was not subscribed. We could not get subscribers to the capital to pay up their calls. We wanted something to live upon ourselves. We pay them a percentage on all receipts.

Mr. Tallerman said they paid them 30 per cent. for what they received in the allotment of shares. He considered, and he said it respectfully, that there had been a most shameful mismanagement of the assets of that company (applause). Before he went further, he would submit one or two notes which he had made, and which he would have verified at the meetings of the shareholders' committee of inquiry, had not his presence there been objected to on very technical grounds. He was objected to by the managing director. He held £500 shares in the company, but £300 only were on the register.

The Chairman: Were you named a member of the committee?

Mr. Tallerman: No.

The Chairman: I think you will all agree with me, gentlemen, that if a committee of shareholders is apppointed and at its meetings the members find a gentleman present who was not named on that committee, who wished to sit in opposition to them, they were not far wrong in not allowing him to remain (applause).

Mr. Tallerman: I was at that committee's meetings by invitation.

The Chairman: By whose invitation?

Mr. Tallerman: Mr. Dadson's ("Oh! oh!" laughter and applause).

The Chairman: I think you will all agree with me that only those gentlemen who were nominated members of it had a right to sit on that committee (applause).

Mr. Tallerman (continuing) said he bowed to the decision of the committee and left, but he should like to have remained (laughter and hear, hear.) He had now to place several facts before them. With regard to the Lancashire Maxim-Weston Company. There was a prospectus issued by that company on September 20th, 1882, and he found from it that not alone was their chairman a director of the company but also Mr. Watt, their managing director. The chairman of the Lancashire Maxim-Weston Company was the Earl De la Warr, and there were two other directors; in fact he found that there were five directors on the Lancashire company who had a strong family likeness to their directorate and the directorate of the Indian company, which had never paid them anything.

The Chairman: No allotment took place, and those who promoted that company had to bear the heaviest expenses. Therefore that company might be considered not to have existed.

Mr. Tallerman was simply dealing with the position in which they found themselves and to what the chairman attributed the loss. He (the chairman) attributed their position to the loss on contracts and to the large amount of money paid, with the consent of the shareholders, to the promoter of the parent company, and there was no doubt a large amount of money had gone there, but a large amount had also gone on obsolete patents; in fact, the directors had been unable to deal with things in general. They looked to their directors to manage their affairs with some sort of intelligence; they looked to them, after having thrown their money away on worthless patents and undertaking contracts without having looked into them, not to turn round and get up companies in the way these had been got up, and which had paid them little or nothing (applause). He wanted to show whether the gentlemen who formed the Lancashire company and the gentlemen who formed the British Indian company were the only capitalists in London able to put their hands in their pockets and support a legitimate company if it was properly brought out. The Lancashire company, as he had said, consisted of five directors, the chairman, Mr. Watt (their managing director), the Earl De la Warr, and two other gentlemen he knew nothing about, Mr. Roberts and Mr. Whitworth.

The Chairman: Mr. Roberts and Mr. Whitworth are well-known in the commercial world.

Mr. Tallerman took the 3 out of the 5. The electrician of the company was Mr. E. H. Thomson, who was the manager of the parent company.

The Chairman: No, sir.

Mr. Tallerman: He was the electrician.

The Chairman: No.

Mr. Tallerman said at any rate he wanted to know what the Lancashire company had got from them, and what they had got from the Lancashire company. The concession conferred on the Lancashire company the following advantages, according to their own prospectus:—The first paragraph explained that they were to have a right in all the patents the parent company had or were entitled to under the existing agreements. The second paragraph gave the name of the towns and districts conceded to them; the third and fourth dwelt upon the prestige and distinctions obtained by the lights—how much superior they were to everybody else's; the fifth and sixth mentioned that the business transferred was a going concern, and gave the names of theatres and warehouses being lighted, and contracts obtained, and prospects of an enormously increased business; the tenth said, "The risks and losses attaching to the initiatory period of such enterprises as the present have been borne already by the parent company, and this company will start free from such responsibilities, profiting by the costly experience already acquired, and being handed over a profitable business. Under the able management of Mr. E. H. Thomson, the well-known electrician, who has formed the business, it will be able to extend its operations under conditions which will insure commercial success." The eleventh paragraph went even further, and stated with regard to the probable profits, "it being estimated that not less than 10 per cent. (dividend) can be paid for the first year from the contracts already secured and in treaty," besides profits arising "from the sale of lamps and dynamos." They were not handing over a concession or dealing with an abstract thing, but they were handing over a business, according to their own statement. Either that prospectus was true or it was untrue. If they had obtained nothing, he said, as directors of that company, the chairman and Mr. Watt had not acted conscientiously or done right. (Cheers.) Further on in the prospectus they said it would therefore be seen that this Lancashire company "starts under conditions very different from any concession company in the kingdom." He was not surprised it did. He questioned if any other company would have sold the business on such terms as they had. (Hear, hear.) On the terms upon which they had parted with it he should speak a little less confidently until he got corroboration from the chairman. He believed, however, the figures he had were pretty correct. They stuck on to their prospectus "We also estimate that the entire sum paid for the above valuable concessions and business can be obtained by the sale of three or four sub-concessions to towns or small districts in Lancashire. As pointed out in the prospectus, the company obtains the only electrical business at present possessing large and valuable contracts in this district, and daily applications are being received for the lights on similar or even more favourable terms to contracts concluded." There was no reason, so far as he could see, that there needed have been any hurry about parting with that business. Commercial men would tell them sacrifices were sometimes made; that they had been compelled, in order to get a large amount of ready cash, to do many things; but a large amount of ready cash did not seem to have been handed to them even though they had so few assets. It seemed an extraordinary thing for their managing director and the chairman and one or two others to transfer to the Lancashire company what appeared to him the only piece of business the company had which was likely to pay a profit. Why did not they sell the City contract by which they were at a loss? (Hear, hear.)

The Chairman: We should have been happy to have sold it to you if you had liked to have bought it (laughter).

Mr. Tallerman said there was no advantage in selling a business for nothing or little or nothing.

The Chairman: Remember, sir, we have not much intelligence (laughter), and I cannot carry in my mind all these objections.

Mr. Tallerman was sorry if he had said anything out of place on the spur of the moment ("Time, time" and "Go on"). The statement as to a dividend which he had quoted from the prospectus was corroborated by Mr. E. H. Thomson in his evidence on the four days' sitting of the committee of inquiry; he stated he expected his company would pay a dividend in June next. Plant was also handed over to the Lancashire company at cost price (Mr. Watt: No), the cost price being £4,184, and additional plant supplied of the value of £1,742, making £5,926. The amount paid by the Lancashire company was £3,923, leaving it a debtor to that company in respect of plant in £2,003. That sum with the £10,000 part of the purchase-money was to be paid if the Lancashire company got a certain quantity of their shares allotted. And was not all the expenses of floating paid by the parent company? They had handed over a business, and they had handed over contracts, and he was told that they had also paid for the promotion and expense of floating that company. The working expenses of the Lancashire company, £335, had, he believed, been paid by their own company, which with Mr. Harding's claim of £609, which was disputed, but for which they might be liable, made £944. They had received £95 for lighting. They had paid £656 in advertising and legal expenses, £250 for commissions, and Mr. Watt, he believed, had got £250, making a total outlay in floating the Lancashire company of £2,005. He should like to know whether that amount had been justly spent in starting a company which was to take over one of the only pieces of profitable business they had (applause, "Time," and interruption). He should like to know what other company——

Mr. Watt (amid the interruption): I do not think we are entitled to a speech from Mr. Tallerman.

The Chairman: I shall leave the meeting to say when Mr. Tallerman should stop. (Renewed interruption and a Voice: What do you want to show?)

Mr. Tallerman wanted to show that the Lancashire company had become possessed of one of the only valuable assets they had and had paid little or nothing for it.

The Chairman: We have already heard you say so, and we do not require to hear it repeated (hear, hear).

Mr. Tallerman also wanted to show them two or three other things. (Cries of "Oh, oh," and "Sit down.") By an agreement dated the 16th September made with the Lancashire company, there were £10,000 in cash to be paid and £10,000 in shares. If the directors had adhered to that agreement he did not think there would have been any complaint, but about four and a half months after that agreement was made it was cancelled and a second agreement entered into by which the cash payment was deferred to an indefinite period and under certain conditions which might never come about. That was done by the chairman and Mr. Watt, their managing director, who were virtually the Lancashire company (interruption).

Mr. Watt: No.

Mr. Tallerman: You are, sir (continued interruption). You turned round and cancelled or vitiated the first agreement and deferred the cash payment. Instead of being paid cash we are to be paid provided a number of shares are taken up and allotted to a foolish public (laughter).

The Chairman: Time is rather valuable; do not please to repeat.

Mr. Tallerman, continuing, said an arrangement was made with two gentlemen (Messrs. Dadson), whom he did not accuse of being guilty of any impropriety, to give them the call of the £10,000 shares that they were to have as purchase money at 17s. 6d. for six months on condition, he believed, that they applied for a certain number of shares in the Lancashire company. That might be true or not, but he had every reason to believe it was correct. There was no quotation for these shares, and they might be handed back to them when they were absolutely worthless. He wanted to know how it was they parted with the only available asset they had. (Cries of "Time" and general interruption.)

The Chairman: Do you wish to hear him, gentlemen? (Loud cries of "No.") I was in hope this discussion might take place at the special meeting. I hope to have it all discussed then, but we should now get through the formal business of this meeting.

Mr. Tallerman: I shall not detain you, but—— (Uproar.)

The Chairmain (to Mr. Tallerman): Shall I reply to you at the special meeting?

Mr. Tallerman (continuing amid the interruption) pointed out that the Lancashire company was registered as having had calls paid to the amount of £16,574; but part of that was only on paper, namely, the 10,000 shares to be handed to their company, on which Messrs. Dadson Brothers had a call, so that the cash they actually got was £6,574. The amount subscribed, but not half paid, was £14,038. Mr. Dadson had taken 2,500 shares in the company, and Mr. Harding 5,000, together 7,500, which, with the call of the 10,000 shares of Mr. Dadson, made the Messrs. Dadson and Harding interested in the company to the extent of 17,500 shares, against the public interest of 4,500.

The Chairman: You need not allude to the call, because it has expired.

Mr. Tallerman: I am justified in saying the call had been made.

The Chairman: Conditional on the raising of a certain amount of capital.

Mr. Tallerman contended that he was perfectly right in his figures, and, while being continually interrupted, went on to prove that the company was barely solvent when the directors handed over the £2,000 worth of plant.

Mr. Allender said they were perfectly well aware that Mr. Tallerman was not entitled to sit on the committee. They, however, found Mr. Tallerman knew a great deal about the company, and when he (the speaker) allowed himself to be nominated on that committee it was with the full intention of using every possible means to get information for the shareholders—(applause)—and his suspicions were considerably roused when he received a private note from the managing director, asking him to come round to his office. Mr. Tallerman also wrote him a note, and he saw that these two men were at daggers drawn. They did get important information from Mr. Tallerman, which showed the reason of the great animus of the managing director to him. It arose out of the fact that Mr. Tallerman was a member of the syndicate for obtaining the concession of the Australian patents, and it was only when words got so high and when the language used by Mr. Watt was so violent and disgraceful —("Oh, oh")—that they decided to proceed without Mr. Tallerman.

Mr. Wm. Abbott suggested that the proprietors should sink personal differences and get on with the business of the meeting. They had to decide whether they would pass the accounts or whether they would not. If they did not they would not have much confidence in their board (hear, hear); if they did they would exonerate the board. It seemed to him a very serious step, considering the amount which had already been expended without any result in dividend, to sanction the increase of their capital to £500,000, unless they saw their way to elect a board of men of experience (applause).

The Chairman put the question as to whether or not the accounts were to be passed, and said it was quite immaterial to the directors whether they were or not.

A Shareholder considered they ought to have some explanation of the value of the 10,000 shares. (Hear, hear.)

The Chairman was ready to give that explanation. They did bring out the Lancashire company, and he thought it necessary for him to go a little way back to show how that company came into existence. Mr. Harding, of the present company, seeing there was great advantage to be obtained in having a subsidiary company at Liverpool, endeavoured to get one up. Mr. Harding found Mr. Thomson, their engineer, understanding electrical matters well, and through him the theatres were lighted and all the arrangements made, the stock being bought from their manufactory, and a certain amount of business done to show the people of Liverpool and Lancashire what these lights were, with the full understanding by the parent company when that was established they should start subsidiary companies. They did, therefore, exactly the same as the Brush Company did. Mr. Harding, in conjunction with a friend, tried to start a Liverpool and district company, but failed. Mr. Watt, who had been lately appointed their managing director, said, seeing he had a large connection in Liverpool, he thought he could get up a company. He went there, and he thought he was not wrong in saying he got £5,000 among his own friends, and, with Mr. Thomson, succeeded in so far establishing their system in Liverpool that two other companies that tried to light up the district withdrew, and theirs was the only electric lighting company going on in Liverpool. It had been shown to the Lancashire people that they could light them up well, and to Mr. Watt was due the credit of getting up the Lancashire company.

A Shareholder: What was he paid for it?

The Chairman said Mr. Watt asked nothing for it, while other promoters asked large sums, but they, as a board, found in looking through their articles that they were at liberty to remunerate any director who did special service, and they decided to give him 250 shares of the Lancashire company, but these had not been given him yet. The company was floated, and it was not their fault they did not get their capital. He had the list before him of gentlemen who did subscribe, and he saw one face who owed to that company £6,670. The Lancashire company were unable to pay the parent company unless they had cash in their locker, and finding they could not pay, a mutual agreement was come to between the directors that they should pay a percentage to the parent company on all money subscribed. Was that not common-sense under the circumstances? (Hear, hear.) Was there anything improper or irregular in that? The Lancashire company now received the advantage of all the contracts, paying for the material that they took from the parent company, and carrying on the business as the parent company could not have carried it on. They had done the best for the company——

A Shareholder: What company?

The Chairman: For the parent company in selling to the Lancashire company, and the Lancashire company had done their best in keeping the work going. They gave the plant, which was to be paid for, to the Lancashire company, so that they might exhibit their lights and in that way start the company. That was the history of the company as it stood; and the parent company was receiving money, and would not have had money in their lockers at all but for the Lancashire company. In regard to Mr. Tallerman's interest in the company, he should mention that his introduction was his coming to him (the chairman) and asking if he would give him a concession for the Australian companies on about as hard terms, he thought, as he ever heard in his life; and if these terms were described to them now, they would say, "Well, you must be a parcel of idiots to agree to such a thing as that" ("Oh, oh"). Mr. Tallerman was buying the concession for himself, and he afterwards formed a syndicate. They fought to get what they considered their rights, and he fought to get the best of them, and after a deal of fighting, Mr. Tallerman got the concession.

Mr. Watt, who had twice previously risen to reply to Mr. Allender, but did not get the opportunity to do so, now said he should shortly explain to them how it came to pass that he sent a note to the committee who were appointed to deal with the question of the future finances of the company. Mr. Dadson and Mr. Swabey called upon him, requesting him, as managing director, to be good enough to go to a meeting of the committee to say that Mr. Tallerman, being an interested party in another concession, was not a proper man to sit on the committee. As the committee had been appointed without any power to add to their number, his taking his seat was irregular, and in consequence of Mr. Dadson's and Mr. Swabey's request he sent that note. As managing director of the company, he challenged any man in that room to say he had ever refused any information as to the affairs of the company since he joined the board. And in regard to the colonial concession he might explain that it was given before he joined the board; therefore how could he be to blame for such a thing as that? He did carry through the Lancashire company, and for doing so he was to receive a qualification of shares; but he had not received a farthing to that day, Mr. Dadson having received a call of those shares. The concession itself had cost him £250 in running to and from Liverpool ("Oh!"). In answer to Mr. Tallerman, Mr. Harding had no legal claim on the company he having failed in his undertaking. That concession cost them £800 or £900, and if they had not received the £3,500 the company would have been insolvent six weeks after he joined the board. In regard to the balance-sheet, he wished to point out that much of the expenditure had been incurred in the previous year, although it was dealt with in the expenditure of that year. As to the manufacture of lamps. When he joined the Board the Maxim's cost them 17s. 6d., at present they cost 2s. 6d.; and the Weston's £7, whereas they now only cost £3. If they took the revenue of their lamps and installations weekly for the last three months the total revenue would be £300 and the total expenditure £100, so that with a little more capital on the basis of the last three months they could make a profit of £10,000 per annum. He did not think he could be held responsible for what was done prior to his joining the board. He had paid all his shares at a premium, and all that he had received to date—in nine months—was £41 9s. 8d. (laughter).

A Shareholder: The question is as to whether or not the accounts are to be adopted (hear, hear).

Mr. A. W. Dadson said his name had been freely mentioned in connection with the Lancashire company, and in that as in most others there were two sides to the question. His brothers during the fifteen years they had been in business had never before issued a writ, but they had felt themselves so foully dealt with in that matter that they had given a writ to every one of the directors of the Lancashire company, and in the law courts would come out the story of the Lancashire company. The question they had to consider was what could be done to improve the dilapidated state of the company. The committee had given the directors a report in which they said, while for the success of the company increased capital was absolutely necessary, they had no hesitation in recommending the shareholders to increase their capital, but only with a guarantee of essential changes in the future management (applause). He had perhaps been one of the largest and most staunch supporters of the company while it had been in existence, and he had no hesitation in saying that he should resist to the utmost any extension of capital with the present directorate (cheers). He much admired Mr. Watt's energy, but with due deference to that gentleman he was not going to trust blindly the management of their affairs to Mr. Watt or Mr. Anybody else, and the management of their affairs now was in Mr. Watt's hands alone. While he should resist any proposal to increase the capital with the present directors in power, he was determined to assist, and would assist, and go ten times beyond anybody else in assisting the company. He did not know whether they should be in order then in saying that they did not accept the report (hear, hear, and "Yes"). Mr. Dadson proceeded to refer to Mr. Swabey being now on the directorate, when

The Chairman explained that they had elected Mr. Swabey to the board that day in consequence of his having brought him a paper signed to the value of 25,000 shares, requesting that he should be elected on the board. He (the chairman) had been ready to resign his post for the last six months. They had had no fees for the last six months (laughter). It was not on that account (renewed laughter). They would not find many gentlemen of mercantile experience to take the management of a company, and stand up and be fired at as they had been fired at, and work hard and take shares in a company which they never expected to get returned, merely for the good of the undertaking. They had for a long time been ready to give up their posts, and in asking them to re-elect the two gentlemen who retired by rotation it was not because they had any desire to be placed on the board. The directors must have seven days' notice. In the meantime they did not expect them to leave them in the lurch without their having anybody to take their places. The re-election of these two directors was a mere matter of form.

Mr. Dadson said they had just now been informed the chairman wished to retire. During the last six months he had heard that the directors wanted to retire; these retirements were on the minute books of the company and had been accepted, but still they were on the board again.

The Chairman: There has been no gentlemen to take our places.

Mr. Dadson: Would you, directors, at the present moment put your resignations in our hands?

The Chairman: We did that long ago.

Mr. Dadson: Do all the members of the board now resign?

The Chairman said they were quite prepared to retire and had been for some time, but they now made this exception. He held in his hand a report which was drawn out by a committee which they called together themselves to advise them as to increasing the finances of the company. In that report there was an expression which he must insist on being proved or withdrawn. He needed not then allude to it further than to say it was to the effect that the directors had "frittered away the means of the company." That should be proved or disproved.

Mr. Dadson, continuing, explained that Mr. Swabey sat on the committee of inquiry which gave that report, that he signed the report, and immediately afterwards he went and joined the directors. What right had any gentleman to be elected to the board within the last few days?

Mr. J. S. Campbell said, considering the holders of 25,000 shares requested Mr. Swabey to be put on the board, he thought they were entitled to do so.

The Chairman further stated that they elected Mr. Swabey out of compliment to the committee and the other shareholders. ("Oh! oh!").

Mr. Dadson: Gentlemen holding 50,000 shares take an opposite view as to the right of his election.

Mr. Griffith said it was really of little importance to the society whether one gentleman wished to be a director, or not. The committee, he thought, ought to have circulated their report. They should have then been in possession of information upon which to have acted. It was rather against the committee that they had kept their fellow-shareholders in the dark.

The chairman was then requested to read the report of the committee, which was to the effect that the members of the committee, had, with the assistance of the officials of the company, investigated their present position, and were satisfied that the company was sound, so far as liabilities and assets were concerned, and that in its excellent patents they possessed property of great value, the realisation of which depended mainly on the management. For the success of the company it was absolutely necessary that they should raise further capital. They were of opinion that the directors had frittered away the means of the company, and that a change in the management was necessary.

After some further discussion, in which there was considerable interruption, the meeting refused, by a large majority, to approve of the accounts, after which

Mr. Dadson suggested that the meeting should be adjourned.

The Chairman: I am going to insist on the committee showing how we have frittered away the money.

A Shareholder: You have got no money, therefore it must have been frittered away.

It was then agreed that the meeting should be adjourned till that day fortnight, in order that further inquiry might be made into the accounts.

Mr. Dadson wished to know whether he would require fresh proxies.

The Solicitor having examined the proxies, said they were for that meeting or any adjournment of it; therefore fresh proxies would not be required.

A Shareholder: I propose you (the directors) should retain your seats till next meeting.

The Chairman: Well, I suppose we must.

Mr. Dadson: Can I put any one on the board within the next seven days?

The Solicitor: You can give notice during the adjournment.

The special meeting, which was to follow the ordinary meeting, was formally held, and also adjourned till that day fortnight.

In the course of the proceedings, and at their conclusion, considerable excitement was shown by a few of the proprietors.

Reuter's Telegram Company (Limited).

The nineteenth ordinary general meeting was held at the company's offices, 24, Old Jewry, on Wednesday, Colonel James Holland, the chairman, presiding.

The Secretary having read the notice convening the meeting,

The report of the directors was taken as read. It stated that the net profits for the year ending the 31st December last, after payment of current charges and deducting rebate on unexpired subscriptions, amounted to £1,380 18s. 4d., including £236 19s. 9d. brought forward from the last account. The extraordinary outlay entailed by the late events in Egypt had materially affected the profits in 1882, as compared with former years. The termination of the war in September last had, however, been followed by a considerable reduction of the extra charges, and the directors were able to state that the business of the company had now returned to its normal condition. In accordance with the articles of association, which authorised the appropriation of the reserve for the purpose of equalising dividends, directors had transferred the sum of £2,500 from that fund to the profit and loss account, making the total amount available for distribution £3,880 18s. 4d., and leaving a reserve of £7,499 9s. The usual interim dividend of 2½ per cent. was paid in October last, and the directors now declared a further dividend of 4s. per share, making a total distribution, free of income-tax, of 5 per cent. for the year. That would absorb £3,787 19s. 8d., and leave a balance of £92 18s. 8d. to be carried forward.

The Chairman said the report explained the main cause of the deficiency in the profits in the past year. That was their 19th ordinary general meeting, and it was, he was sorry to say, or rather he was glad to say, in one sense, the only meeting at which they had had so sorry an account to show to the shareholders. The main cause had been the Egyptian war. So much interest was naturally taken in that war, it being so close to home, that they felt bound to have frequent and full reports of what was going on. Not only had they daily reports, but they on many occasions had hourly reports, and he thought those who bore in mind the telegraphic intelligence received from the seat of war would agree with him when he said nothing could be more full, more complete, or more correct than the information they conveyed; but war was an expensive matter, not only to the Government, but to those like themselves whose duty it was to convey the intelligence to the public, for they had to pay, and pay heavily, for every telegram they received and sent, and they felt it to be their imperative duty, considering that the war was of interest and importance to the country, that that intelligence should be full and correct at whatever cost, for it was their life's blood that they should be first in the field, be most correct, and that no one should be before them. The telegrams alone from Egypt cost upwards of £3,000 more than the ordinary amount disbursed, and they had fully £1,000 more to lay out in payment of special correspondents and agents engaged on their behalf to furnish the intelligence. There were other minor charges affecting their home establishment in excess of the ordinary charges. They also had in addition to the war in Egypt a small war in South Africa where an endeavour was made to compete with them in the furnishing of information. That competition they succeeded in overcoming, but again the cost was considerable. There was another item that swelled the expenses. Their worthy secretary had been employed on a tour of inspection in India, and had done good service. The work was laborious and the travelling expenses were heavy, but they were not likely to occur again for years. All the charges he had mentioned he trusted were exceptional. Unless they had fresh wars or fresh agitation they might expect soon to recover to their normal state. There was always more or less a silver lining to every dark cloud, and they would find from the statement of accounts that the subscriptions, commissions, &c., had increased by about £900, showing their business was by no means falling off. While the expenditure was exceptional, the source from which future profits might be derived was progressing in a very satisfactory manner. He concluded by moving that the report and balance sheet be received and adopted.

Sir John Hay, M.P., seconded, and the motion was unanimously carried.

On the motion of the Chairman, seconded by Mr. J. S. Stopford, Sir John Hay, the retiring director, was re-elected.

Messrs. Quilter, Ball, Crosbie, Glegg and Welton, the retiring auditors, were also re-elected.

A vote of thanks to the chairman closed the meeting.

The Weston Union Telegraph Company.—At a meeting of the shareholders of this company, held in New York last week, the lease of the Mutual Union Lines and American Cable was formally ratified.

The Eastern Telegraph Company.—This company notifies the restoration of the Eastern Extension Company's Singapore-Saigon cable. Messages can again be accepted for China, Japan, Manilla, and Cochin China, "*vià* Eastern."

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